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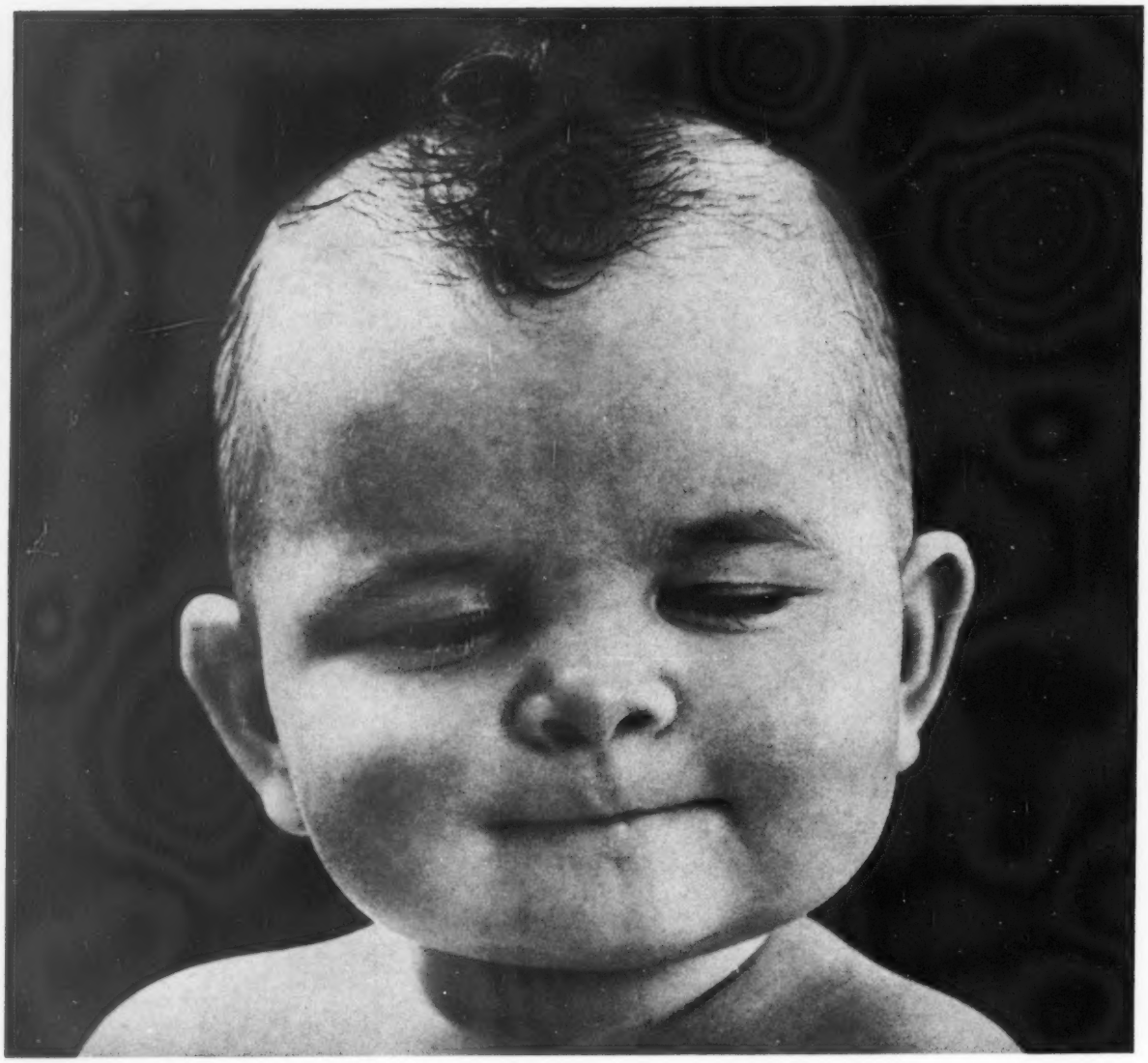

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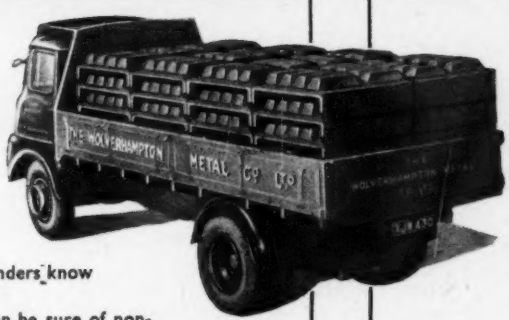

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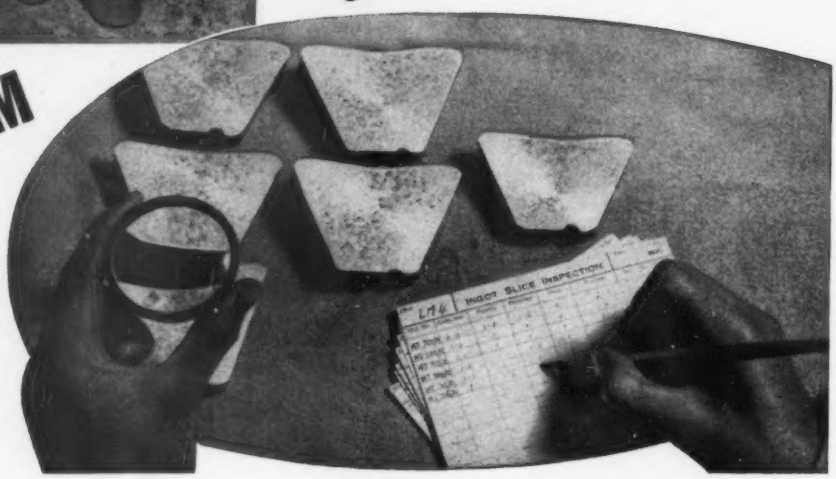

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These illustrations are taken from the latest Intal booklet, giving much interesting information on alloy ingot manufacture. We shall be pleased to post a copy to executives on request.

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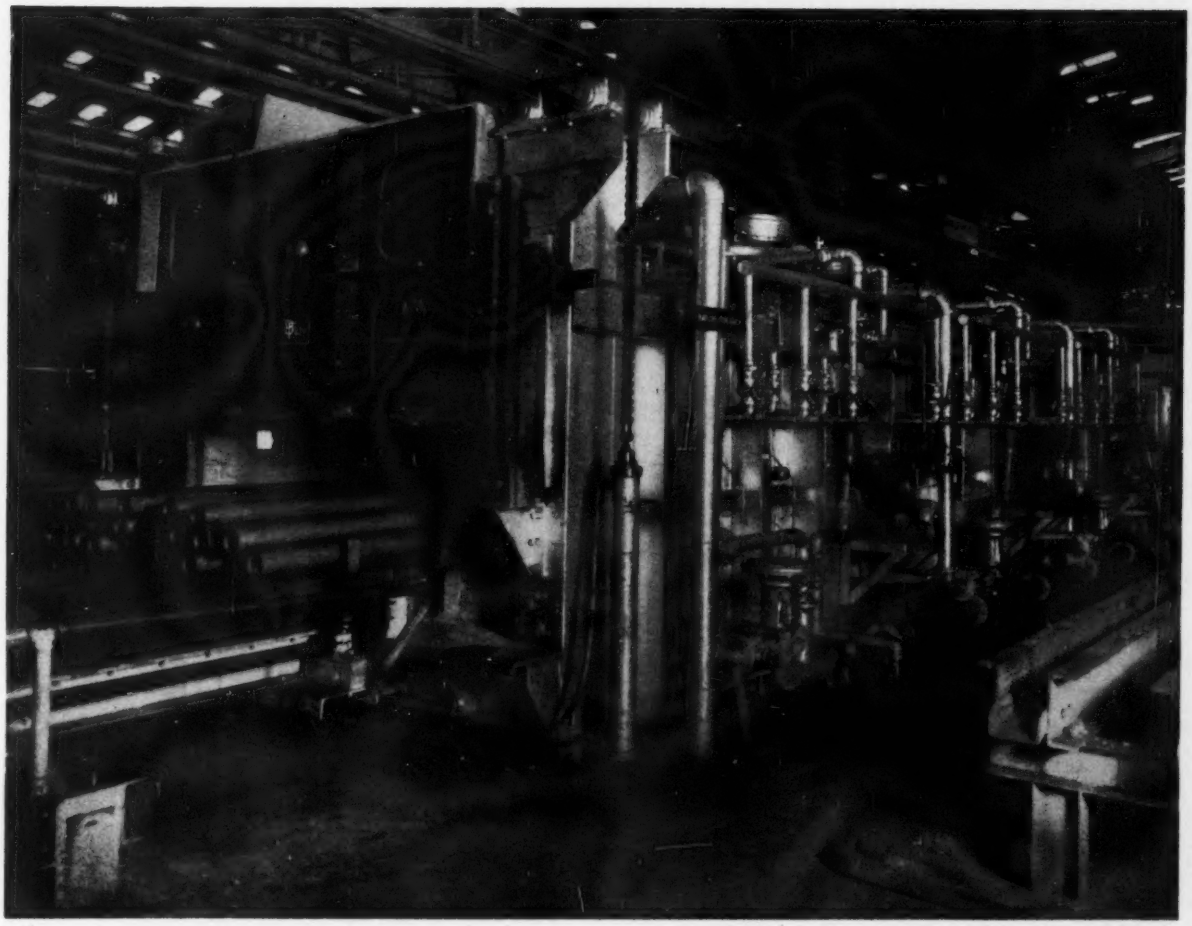

Illustration by courtesy of I.C.I. Metals Division

Batch Type Annealing Furnace, Town's Gas Fired. 8′ 0″ wide × 30′ 0″ long for non-ferrous tubes, operating temperatures 250°-800°C. Output 3 Tons per hour. Automatic proportioning gas burners give atmosphere control with uniformity of temperature and economy in operation.

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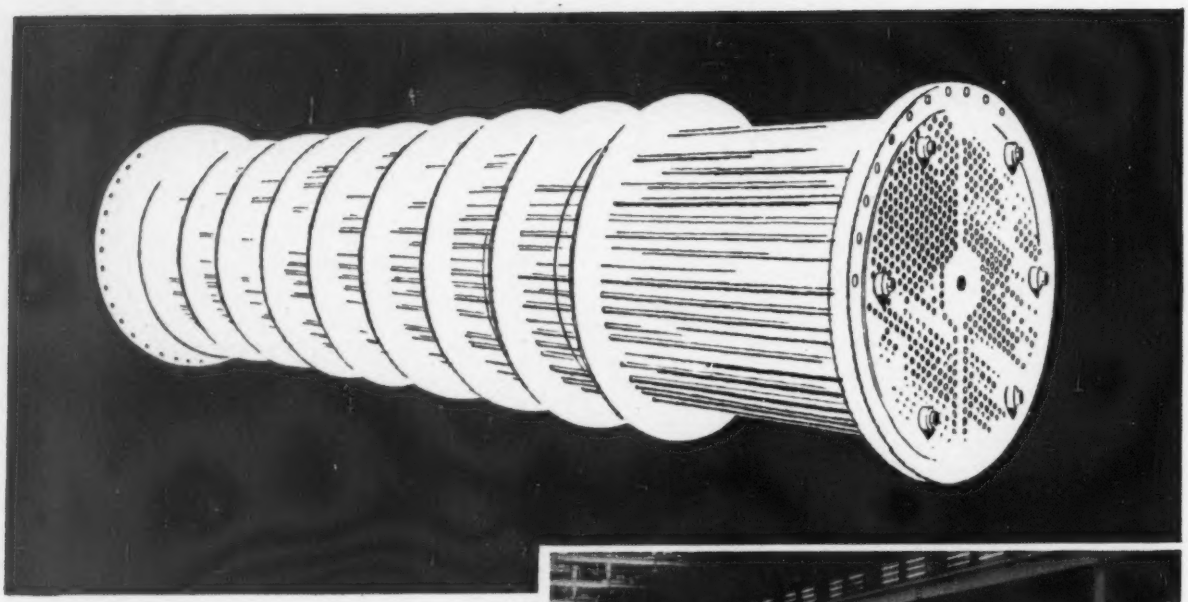

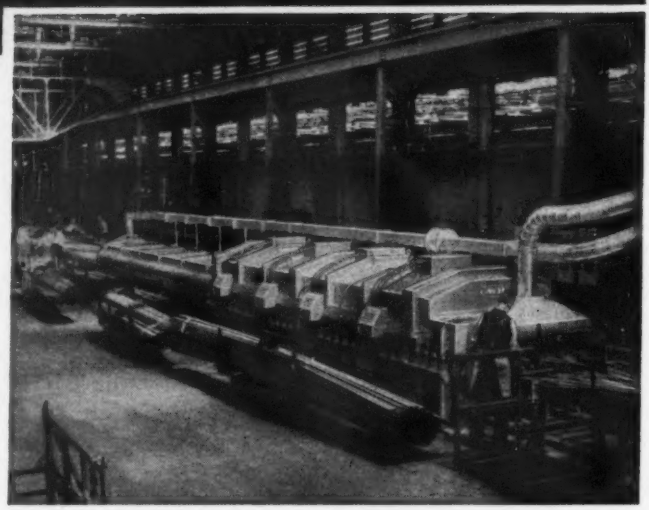

Above is an artist's impression of a large heat exchanger. The photo on the right shows a Driven Roller Hearth Electrically Heated Furnace supplied by G.W.B. Furnaces Limited to Serck Tubes Limited for annealing a variety of non-ferrous tubes including copper, cupro-nickel and aluminium/brass with or without a protective atmosphere. A large percentage of these tubes is used in the manufacture of Heat Exchange equipment, designed and produced by Serck Radiators Limited, and serving a wide range of applications from oil and water coolers for small internal combustion engines up to large condensers and heat exchangers, such as the type illustrated, for the Petroleum, Marine and Atomic Energy Industries.

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RATING: 330 kWs in four independently controlled zones

TEMPERATURE RANGE: 650-750°C. normal
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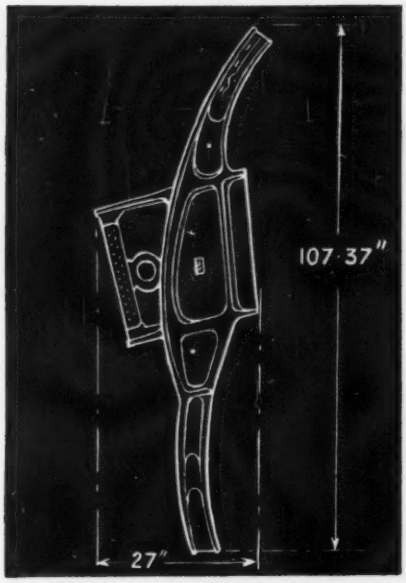

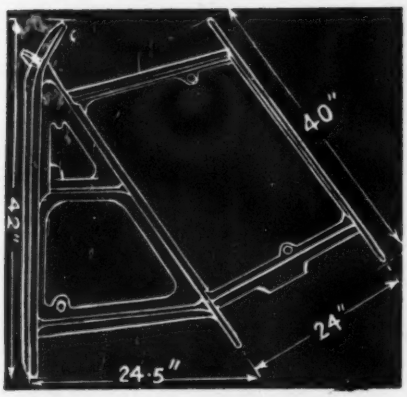

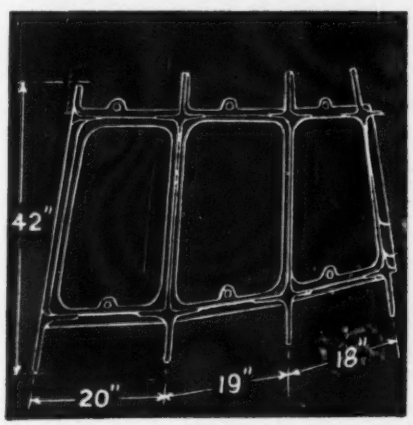

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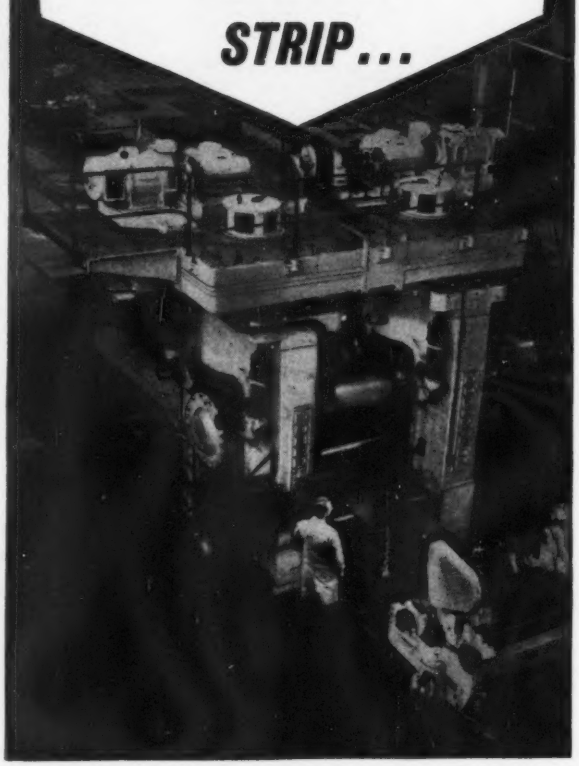

Manufacturing Range

PLATES	Maximum Length	16 ft.
	Maximum Width	4 ft. 6 ins.
	Maximum Weight	12 cwts.
SHEETS	***Cold Rolled***	
	Maximum Width	3 ft. 4 ins.
	Minimum Thickness ...	28 S.W.G.
	Hot Rolled	
	Maximum Width	4 ft. 6 ins.
	Minimum Thickness ...	26 S.W.G.
STRIP	Maximum Width	1 ft. 2 ins.
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For full particulars of the above and other products consult our reference book "Non-Ferrous Products." A copy will be sent on request.

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Electrical Aids in Industry

Data Sheet **No. 9**

Lighting - 3

Data Sheet No. 7 dealt with some actual applications of factory lighting. Further applications are given here.

Drawing Offices

It is fair to say that in no part of a factory is good lighting more important than in the drawing office. The draughtsman's task is extremely exacting and unless the illumination is up to required standards, mistakes, loss of time and greater fatigue will result.

The essential requirements are:

High value of illumination
(*minimum of 30 foot-candles on the boards*)
Absence of shadows
Absence of reflection

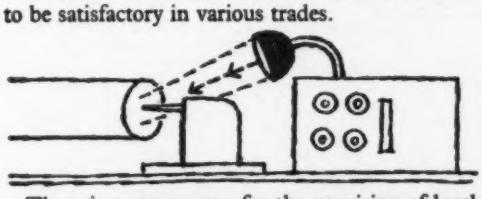
One of the major problems is the reflection of the light sources by shiny tracing paper, instruments, set-squares, etc., and particularly by the extra-hard pencil leads often used. Another problem is that caused by the shadows ahead of T-squares and by the variety of angles at which drawing boards are set.

Fluorescent lighting is particularly suitable because of its comparative freedom from shadow, its natural colour and because it can be localised with respect to drawing boards to avoid reflections while at the same time giving enough light upward and sideways to satisfy the general lighting requirements of the office.

A lighting solution which has been successfully employed for tracing is to light from beneath and through the paper which is fixed on to a translucent panel, thus eliminating the problems of shadow and reflection.

Machine Shops

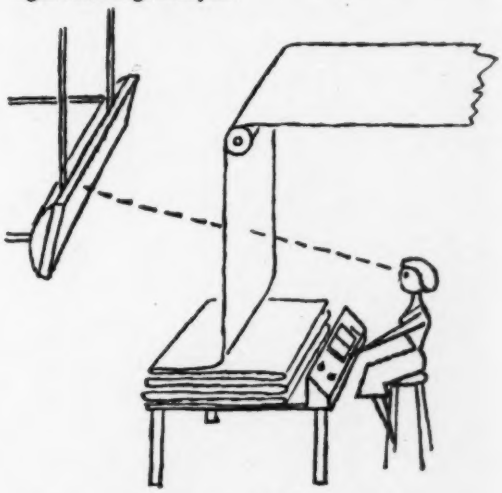
The problems of machine-shop lighting vary so widely that it is impossible to lay down rigid rules which are applicable to all types of machine. Much of the design of such lighting systems must therefore be a matter of individual application. Certain maxims, however, have proved in practice to be satisfactory in various trades.



There is a strong case for the provision of local lighting on many machines to enable the direction of light to be varied to suit the work, or to boost the illumination for fine work.

In shops employing certain machine tools, particularly circular saws, the possibility of stroboscopic effects can be avoided by splitting lamps among the phases of a three-phase supply or by using twin lamp fittings with a split-phase circuit.

Where safety goggles are used, extra illumination should be provided to compensate for the reduced light reaching the eyes.



Silhouette inspection of fabrics or profiles can often be used to advantage by placing a light source behind the material to be inspected — on the lines of the back-lighting already referred to for tracing in the drawing offices.

In general, machine-shop lighting is essentially an empirical science, based largely on a combination of general and local lighting, which offers immense scope for ingenuity.

Outside Lighting

The outside precincts of a factory are often much neglected. No special rules can be suggested for lighting these areas, but speed, efficiency and safety are all dependent on adequate outside illumination during the hours of darkness.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2. Telephone: TEMple Bar 9434.

Excellent reference books on electricity and productivity (8/6 each or 9/- post free) are available—"Lighting in Industry" is an example.

E.D.A. also have available on free loan in the United Kingdom a series of films on the industrial uses of electricity, including one on industrial lighting. Ask for a catalogue.

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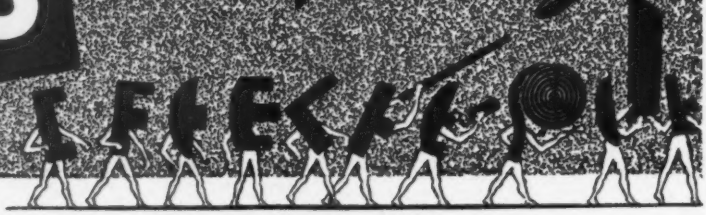

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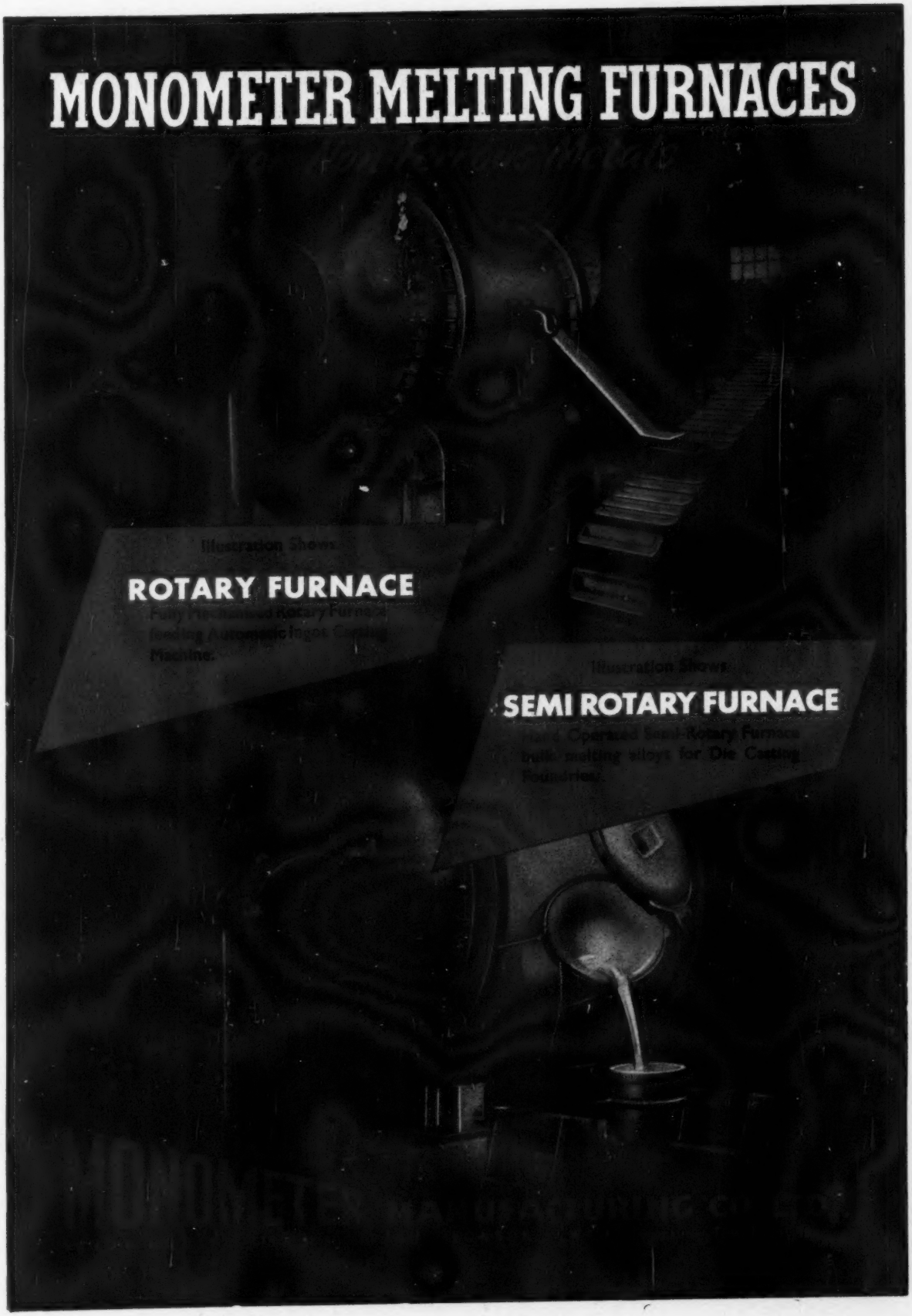
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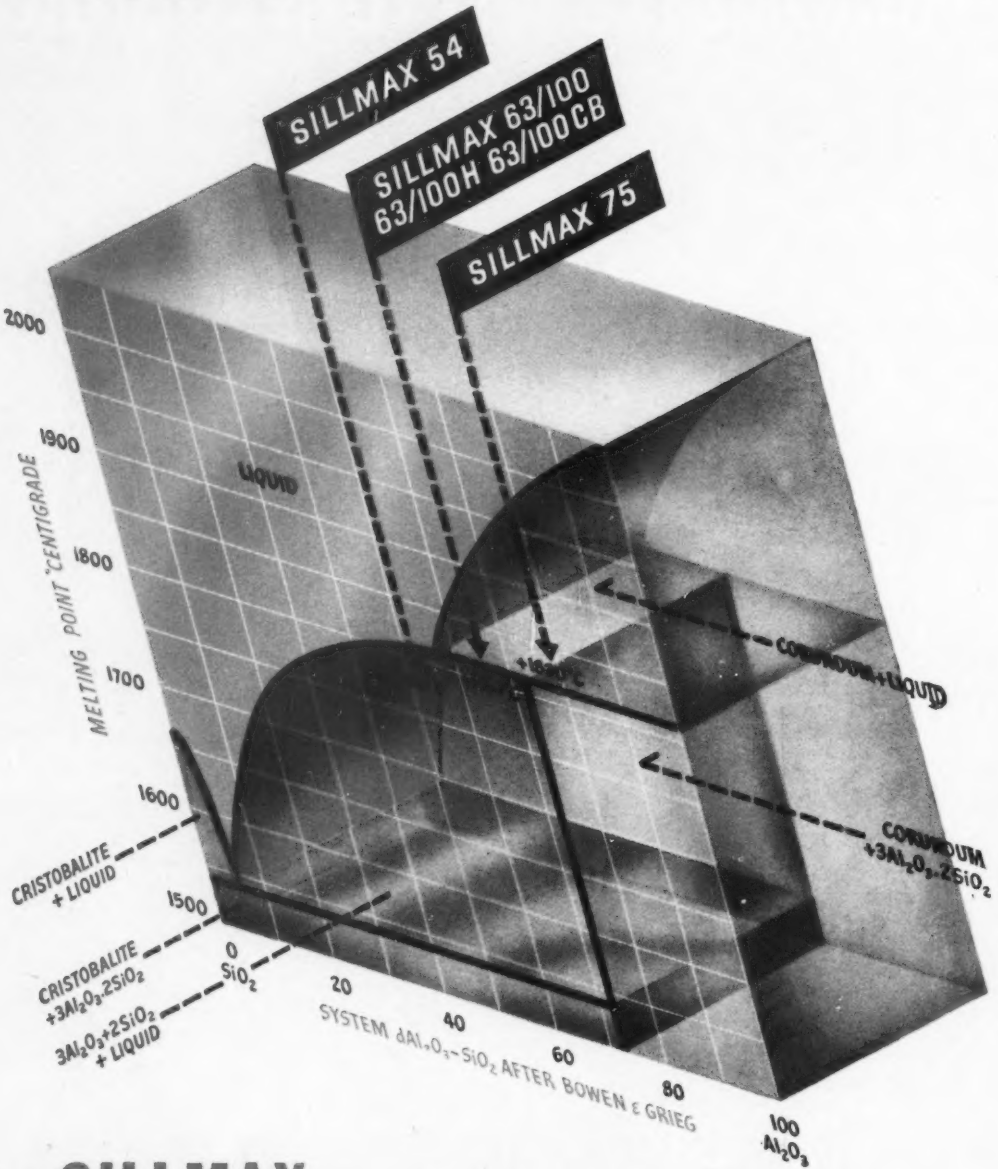

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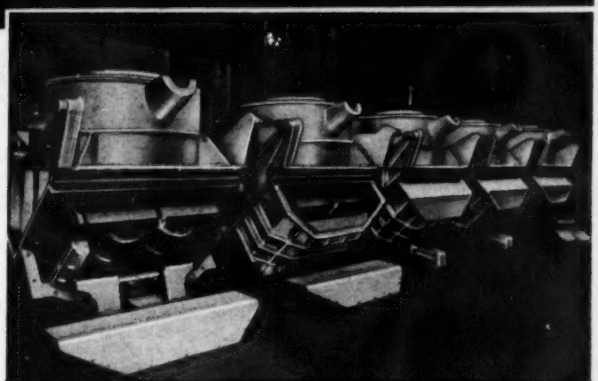

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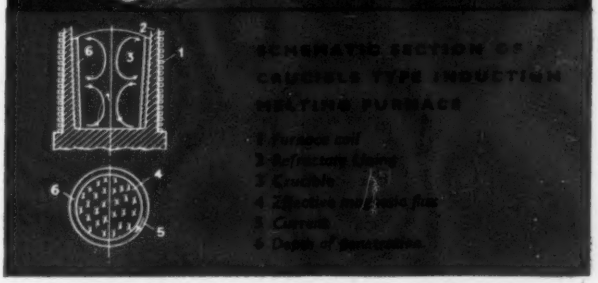

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CONTENTS

	Page
Editorial: Science and Industry	405
Out of the Melting Pot	406
Welding Aluminium and its Alloys	407
Management Techniques	409
Bearing Metals	411
Nesting Die for Batch Production	412
Finishing Supplement: Progress in Polishing	413
Precision Plating	415
Correspondence	416
Reader's Digest	416
Obituary	416
Industrial News	417
Men and Metals	419
Forthcoming Meetings	419
Metal Market News	420
London	
Birmingham	
New York	
New Zealand	
Non-Ferrous Metal Prices	421
Scrap Metal Prices	422
Foreign Scrap Prices	423
Financial News	423
New Companies	423
Trade Publications	423
Light Metal Statistics	423
The Stock Exchange	424

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METAL INDUSTRY

VOLUME 95 NUMBER 18 11 DECEMBER 1959

Science in Industry

ADVICE to firms unsure how much to spend on research, a frank discussion of the frictions that can arise between production staff and scientists employed by a company, a plea for a higher scientific content in general education, and proposals for the creation of a British "Small Business Administration" to make long-term loans to industry, and for Commissions of Inquiry to investigate industries where bad labour relations seem to be endangering efficiency or technical progress, are included in the recently published third and final report of the Science and Industry Committee which, sponsored by the British Association for the Advancement of Science, the Royal Society of Arts, and the Nuffield Foundation, has for several years been investigating the factors which influence the adoption of new scientific ideas by British industry.

A set of general rules is put forward for deciding which kinds of research and development work are likely to be most worthwhile, and for making use of the new ideas developed. Management must be prepared to make full use of such techniques as work study, production planning and control, budgetary control, improved costing and market research, and it should consider using outside consultants. It must also decide whether development or design work it proposes is within the capacity of the firm.

A standard procedure for ensuring that new ideas are quickly picked up and appreciated should help managements to avoid overlooking ways in which the firm can be kept fully open to new ideas. A similar standard procedure, in this case to be followed annually, is set out for the larger firms trying to settle their budget and programme for research. The organizational difficulties of setting up a research department, and ways of avoiding the tensions that can easily arise between research and production staff, are discussed. Small firms are given advice about the amount of research and development work it is sensible for them to carry out themselves, and suggestions are made about getting outside help if it is needed. Another standard procedure covers points that have to be considered when deciding whether the introduction of newly-developed techniques or products will be worthwhile.

It is suggested that technical training is falling behind the training of technologists and scientists. Tax remission for apprenticeship schemes, or possibly a compulsory levy for a scheme of "industry apprenticeship" might produce the rapid expansion in the intake of apprentices which is needed. Universities should take a greater interest in finding the best form of education for future managers, and there should be an increased scientific content in general education at all levels. Finally, the report discusses the effect on technical progress of restrictive practices by both management and labour, and proposes that the Minister of Labour should be empowered to refer to a Commission of Inquiry the general state of labour relations in an industry where it appears that they are such as to endanger efficiency, technical progress, or the competitiveness of British goods in export markets.

It will be up to the Minister for Science, the Lord Privy Seal, to consider most of the problems discussed in the second half of the report. The report says bluntly that "we doubt if it can be said that a Government policy on the application of science really exists. The facts on which such a policy should be based have never been collected or assessed". It calls for substantial research by a group containing both scientists and economists. Such research would make it possible to decide whether, for instance, aid to industrial science should be widely spread or concentrated, and (if concentrated) whether most attention should be given to the weaker industries, or to those which had already proved successful.

Out of the MELTING POT

Applied

ALMOST twenty-five years ago, H. Röhrig reported that he had observed recrystallization in cast specimens of super-purity aluminium and of some alloys prepared from it. Recrystallization, which resulted in the disappearance of the cast structure of the metal, occurred on heating the specimens at temperatures between 610° and 630°C. The recrystallization was found to be independent of the grain size of the cast metal, occurring in both slowly cooled (coarse grained) and rapidly cooled (fine grained) specimens. This observation likewise ruled out the possibility that the recrystallization was due to internal stresses in the cast specimens: the presence of internal stresses in the very slowly cooled specimens was most unlikely. These findings, together with the results of some investigations on the influence of alloying and impurity elements (notably silicon and iron) led to the conclusion that the occurrence of the recrystallization in the cast metal was dependent on all the impurity and alloying elements first going into solid solution at the heat-treatment temperature. There the matter of the recrystallization in cast super-purity aluminium and its alloys appears to have been allowed to rest, until quite recently a practical application for this, at first sight somewhat academic, phenomenon was discovered. The use for it was found in connection with the chemical brightening of cast super-purity aluminium-base alloys. Hitherto the results obtained by chemical brightening of such castings have always been inferior to those obtained when treating the same material in the wrought condition. If, however, the cast metal is caused to recrystallize, in the manner described above, by heating it at a high temperature (temperatures 10°-30°C. below the solidus are recommended) the finish produced by subsequent chemical brightening of the metal is substantially equal to that obtainable on the wrought metal. A further interesting observation is that the high-temperature recrystallization treatment of the cast metal results in an improvement in brightness achieved by treatment of the wrought material that has been produced from the recrystallized cast metal. The same high-temperature recrystallization is also beneficial when applied to certain alloys of lower purity. It ought, perhaps, to be pointed out that in all the above cases, the effects of the recrystallization treatment are much superior to those achieved by the ordinary homogenizing heat-treatment which has on occasions been used in this connection.

From the Past

THERE can be various reasons for turning back and re-examining the scientific and technological past. Thus it was suggested (this page, METAL INDUSTRY, 13 November 1959, p. 297) that new developments could arise from an application of recent experience and achievements, e.g. in the field of materials, to suggestions made in the past and either abandoned because of the lack of such experience and/or materials, or developed along lines which may not have proved to have been the most advantageous or, at any rate, not the only ones. Such suggestions for a re-examination of the past may yet lead to the sponsoring of appropriate research or the formation of an organization for promoting applied research into the history of science and technology as distinct from the purely "pure" or academic work at present being done in this field. Need it be suggested further that such applied research would provide excellent outlets for the abilities, and above all the experience, of those individuals who at present claim to be frustrated by being written off as too old for engaging in current front line research, provided some of them would be prepared to do something about it. Elsewhere, I have since been interested to note (of all things and of all places) the editorial of an American technical journal advocating, for different reasons, a return to the past or, as it puts it, a "re-search". "Too often, 'research' is considered to mean only the forward look. But the word itself suggests something else; 're-search' implies going back to recheck and resurvey, to find what 'laws' are not laws but outmoded theories, what basic errors there may be upon which we've built a house of cards." Warning against the tendency to rush into "hardware", which may very soon prove to be a dead-end design, the editorial suggests that the tendency now is to skip orderly development towards dead-end perfection, by evolving a new process to achieve the same end more economically or more efficiently, thereby giving the design and development of the necessary equipment a long start and at the same time pushing out a long way the dead-end of any such development.

Prospects

JOINING of metal parts by surrounding the portions to be joined by a mould into which molten metal is then cast to form the joint, is resorted to only occasionally (cf. this page, METAL INDUSTRY, 27 November 1959, p. 336). The reasons for this limited use would probably be worth examining since thereby further developments of the method may become apparent. Might not, for example, recent advances in moulding materials and techniques (shell moulding, the CO_2 process) be able to help "streamline" the method? An examination of this nature might well be carried still further in order to consider whether a mould is, in fact, always necessary. In doing this, it would not be covering entirely new ground. The possibility and advantages of a welding process in which the weld metal is melted separately and then supplied to the joint, without the use of a mould, have been examined in the past. They would certainly be worth re-examining, particularly in the light of the new special refractories which are resistant to the action of molten metals and which could, therefore, be used for the equipment that would be required for handling and delivering a closely controlled supply of molten metal to the joint. The absence of a mould to contain the molten metal once it has been delivered need cause no difficulty. The various gas and arc welding processes have developed mouldless control of molten metal to a fine art and/or science. These and other procedures could, therefore, be brought in to help. At the same time, they and the joint would be all the better for the melting, alloying, fluxing, degassing, and temperature control of the weld metal being removed to where such operations properly belong, namely a melting furnace, instead of their being carried out *in situ* in the joint with the exercise of more art and science. And once the practice of melting weld metal apart from the joint has gained a hold, there may even be discovered occasions on which, instead of the weld metal being brought to the work, the latter could be brought to the weld metal: like dip-soldering and dip-brazing, dip-welding may be found to have its uses.

Skinner

SEMI-AUTOMATIC AND AUTOMATIC WELDING WITH THE INERT GAS-SHIELDED METAL ARC

Welding Aluminium and Its Alloys

II—The Consumable Electrode Process

IN the consumable electrode process there are two methods of controlling arc length, one by which the electrode is fed at a constant speed, and the other by which the rate of electrode feed is controlled by an external device.

Both methods give a constant arc length during welding, but whereas in the first method the arc depends for its adjustment on an electrical phenomenon which operates only within a limited range of conditions, the second method relies upon an external electrical control. This is of wider application, and is particularly suited to mechanical welding of plate $\frac{1}{4}$ in. thick and over. It has been accepted by the B.S.I. that these be termed the "self-adjusting arc" and "controlled arc" processes respectively.

With the self-adjusting arc, the operator can control the length of wire projecting from the welding gun by varying the distance between the nozzle and the work: experience indicates a projected length of about $\frac{1}{16}$ in. as the most suitable. Once welding current and wire feed have been set no further control is needed over arc length.

The welding gun should be held so that the arc is directed against the unmelted material ahead of the line of travel. If the gun points the other way, at best a black smut will be left on the weld surface, and whilst this smut can easily be brushed off, it is accompanied by oxide enfoldment and sometimes also by gross porosity.

In the controlled-arc process the arc length is indirectly controlled by the arc voltage. Plate of $\frac{1}{2}$ in. thickness has been welded in a single pass, using $\frac{1}{8}$ in. diameter filler wire at a speed of 18 in/min.—about three times the speed of automatic argon-arc welding with a non-consumable electrode. Again, 1 in. thick plate has been welded at 4 in/min.

The equipment is as used for the consumable electrode welding of other metals, but the supply of argon gas must at all times be sufficient to protect the aluminium electrode, which may project for slightly varying lengths in the course of welding.

The use of D.C. reverse polarity gives effective dispersal of the surface oxide film. An arc length of about $\frac{1}{4}$ in. gives the best results, shorter arcs tending to produce porous welds and longer arcs giving a rough weld bead and reduced penetration. The arc voltage for any wire size varies with current, and normally is between 22 V and 27 V for lower and higher currents respectively.

In certain cases, such as the high-speed welding of thin material, voltages slightly lower than those mentioned may be better. These values are of voltages measured across the arc, not across the generator terminals. This difference is extremely important, because the voltmeter connected—as is usual—across the generator, records (in addition to arc volts) the voltage loss in the cables, earth connections and so on, which amount to 3-6 V—far too big a difference to ignore. Currents of 165-450 amp are used, current densities at the arc normally approaching or equalling 100,000 amp/in^2.

The filler wire, of diameter and composition suitable for the work to be welded, should be hard drawn, free from kinks and have a smooth surface. Although hydration of the surface oxide film does not normally cause trouble with argon-arc welding, it can be a serious source of porosity with self-adjusting arc welding. This is partly because the very high freezing rate of such welds does not give time for the hydrogen to diffuse out before the metal solidifies and it is thus present in the form of porosity. The inherent tendency for trouble from this source is intensified, due to the high ratio of wire surface area to volume consequent on the very small filler wire diameter.

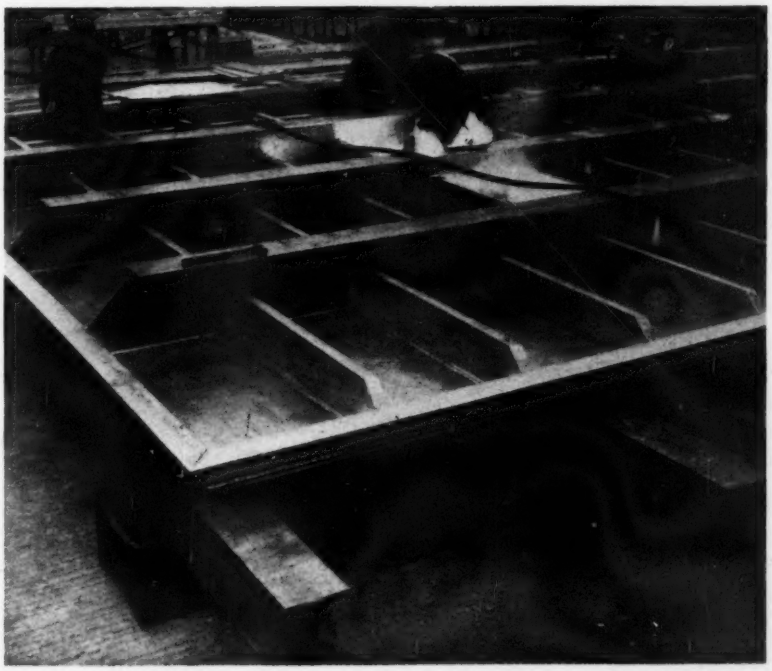
The standard of cleaning must, therefore, be unusually high; special cleaning treatments are used with the object of removing the thick, porous oxide film originally present on the wire and substituting a thin, hard film which does not so readily take up moisture. This cleaning is done by the wire manufacturers, and it is essential that only wire specially prepared and spooled for consumable-electrode welding is used.

Filler wire sizes range from $\frac{3}{64}$ in. to $\frac{3}{32}$ in. diameter, and these are suitable for welds in aluminium parent metal from $\frac{1}{8}$ in. to 2 in. thick. The wire, normally projecting about $\frac{3}{8}$ in. beyond the torch nozzle, can be extended to about $\frac{1}{4}$ in. for welding fillets and reaching other places often inaccessible with the tungsten torch. Welds can be made in all positions with equal facility.

The following data are typical for a $\frac{3}{64}$ in. diameter filler wire making a single-pass weld on $\frac{3}{16}$ in. thick aluminium plate; assuming that idle time is nil, up to 6 lb/hr. of metal would be deposited; current: 155 amp D.C.; argon flow: 30 ft^3/hr; arc voltage: 21 V; wire speed: 200 in/min.; welding speed: 30 in/min.

In a recent alternative design which is claimed to have certain advantages,

Aluminium deep tank hatch cover for M.S. "Kepwick Hall" being welded
[*Courtesy Head Wrightson Aluminium and Northern Aluminium Co. Ltd.*



the wire feed rollers are mounted in the welding head so that the wire is pulled, instead of pushed, through the conduit leading to the gun. This arrangement incorporates a magnetic clutch which simplifies the control circuit: the driving motor runs continuously and rotation is transferred to the rollers, via a flexible shaft, when the arc is struck.

Edges should be cleaned and dried immediately before welding but no edge preparation is required on metal less than $\frac{1}{4}$ in. thick. Indeed, due to the extra deep penetration associated with consumable electrode welding, either bevelling of edges or gap between edges of metal to be joined are likely to be disadvantages. A backing strip is advisable on thin metal.

Plate from $\frac{1}{4}$ in. to $\frac{1}{2}$ in. thick should be welded from both sides, but if this is impracticable, the first run must be made on to a backing bar. On plate, edge preparation and gap are generally recommended, although plate up to $\frac{1}{2}$ in. thick can be welded without edge preparation. A trial run is advisable to determine the best conditions of edge and gap.

Welds in material thicker than $\frac{1}{2}$ in. may be completed in seven or even more runs, depending partly upon the edge preparation and gap. Fillets in $\frac{1}{2}$ in. plate and thicker are made in two to four passes at speeds of 15-25 in/min. with wire speeds of 100-200 in/min., but for most applications one pass is sufficient. Preheating is not usually required.

Self-adjusting arc welding may be carried out by the leftwards or rightwards techniques, or backhand or forehand procedures. Welding is considered by some to be easier — for horizontal joints in the vertical plane— by the backhand method, but welding speeds are generally higher using the forehand technique.

Forehand welding is preferred for welds in all positions, but penetration in fillet welds is usually somewhat less. Backhand welding tends to give convex fillets but the method is always accompanied by some risk of oxide entrapment and porosity.

In the downhand position, the welding torch is usually inclined at 15°-20° to the weld and should be pointed slightly ahead of the deposited metal; in backhand welding the torch points towards the weld metal. The best angles for horizontal and vertical welds are determined by the individual welder, but generally a steeper angle of inclination between the torch and the work is necessary for vertical welds than for horizontal.

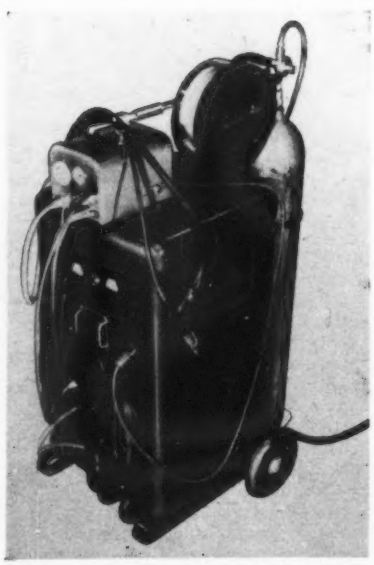
Care should be taken to move the torch along the weld in as steady a manner as possible, for any appreciable tendency to weaving is liable to result in gas pores and possibly oxide entrapment, due to discontinuities in the argon shroud. A gentle backward and forward oscillation along the direction of welding is necessary, however, when welding commercially pure aluminium in order to reduce porosity.

When beginning to weld, the filler wire should extend up to 1 in. beyond the nozzle, and with the torch held away from the work the operating trigger should be pressed for one or two seconds before welding starts in order to give a satisfactory flow of argon through the gas circuit. Then

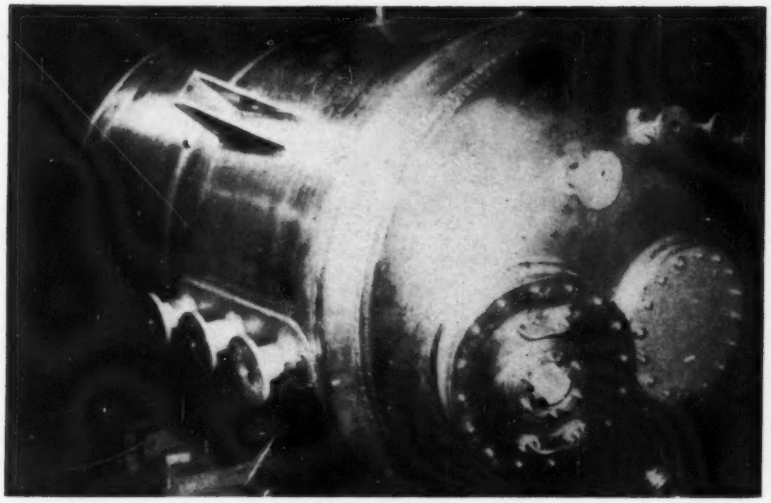
[Courtesy Quasi-Arc Ltd.

Above: Vertical welding of stiffeners to aluminium bulkhead using the Sigma process and semi-automatic Lynx equipment

Left: Diagonal ribs, blocks and bars welded to the inside surface of an aluminium alloy tie beam



Right: Quasi-Arc Lynx S.A.1 equipment including welding rectifier, wire feed and control unit, and welding gun



Jacketted reactor (pressure vessel) with double butt Argonaut welds

the arc is struck on the work or a run-on strip. As soon as welding begins the wire burns back and should project about $\frac{1}{8}$ in. beyond the nozzle.

The arc length should be maintained as constant as possible, and this gives an arc voltage between 22 V and 30 V, depending upon current flow; the corresponding open circuit value is about 70 V. If the voltage is too high, spatter becomes excessive and penetration is irregular, but a voltage that is too low may give rise to an unstable arc and a risk of porosity.

When welding aluminium alloys containing little or no magnesium, the absence of spatter and a steady hum indicate that the voltage and arc length are satisfactory. But in welding aluminium - magnesium alloys it is extremely difficult to avoid spatter and the arc is somewhat irregular, so that it is necessary to have rather more experience with these alloys than with the non-magnesium types. If the arc length is too great, a greater argon flow is required to shield the weld pool adequately. At the end of a run the arc is broken simply by releasing the operating button and drawing the gun back from the work.

It is specially important that optimum penetration is secured both in butt and fillet welds. Chipping back is, therefore, recommended for butt welds whenever practicable or, even better, the welding of butt joints from both sides to give a symmetrical weld. This applies to all forms of arc welds.

The penetration secured in fillet welds made by the argon arc method is less than by the consumable electrode process, and it is more difficult to obtain the required depth as the thickness increases, particularly as there is a tendency for the root to be bridged.

The author is indebted to the Aluminium Development Association for information supplied on which this article is based.

Management Techniques

FOLLOWING his induction as President of the Birmingham Metallurgical Society for the year 1960, Mr. S. G. Temple M.Sc., F.I.M., presented his presidential address under the title "A Metallurgist looks at Management Techniques". Among the observations in this address were a brief look at the history of management techniques and a review of the major techniques in use. Among the specific examples quoted were the following.

The applications of the work study technique for incentive purposes requires a precise definition of procedure and it often falls to the lot of a metallurgist to attempt to define precisely a process which is bristling with variables. For example, the number of passes when rolling copper sheet to half-hard temper on a 2-high sheet mill is virtually incapable of accurate definition, and if average values are used the whole study work may be rendered useless as a basis for incentives. The variations in the properties of brass strip which can arise from trace elements as impurities in the original casting will also affect the subsequent working, and such factors again can render much study work abortive.

Notwithstanding these difficulties, the whole procedure is of great importance. A review of a given study can often help in the solution of many of

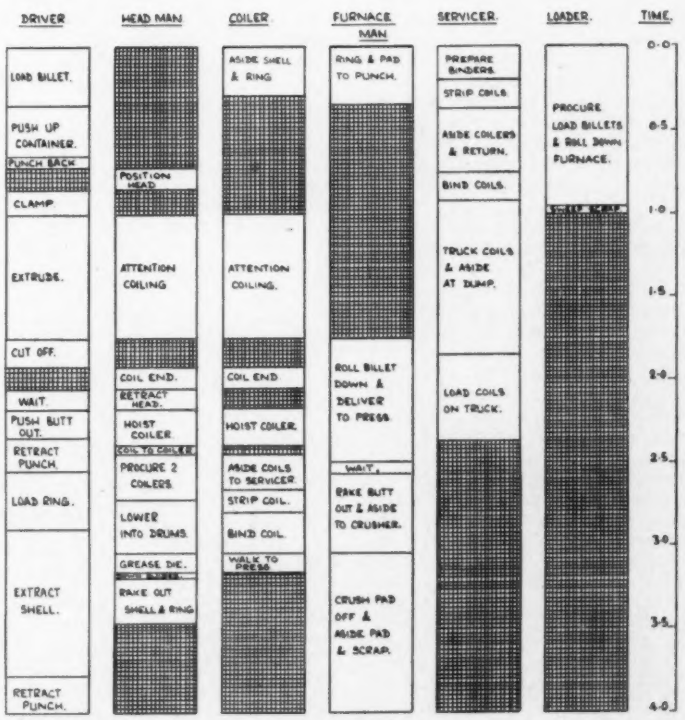


Fig. 1—Multiple activity chart for extrusion press : first method requiring six operators

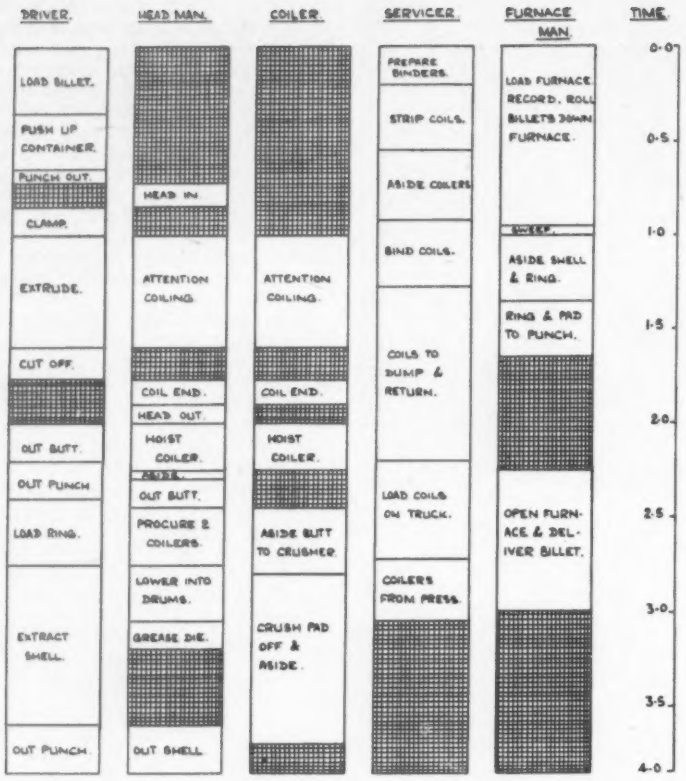


Fig. 2—Multiple activity chart for extrusion press: revised method requiring five operators

the production metallurgist's problems. As illustration a study may be quoted which was made of an extrusion press prior to the application of incentives thereto. Fig. 1 shows the position at the time of the initial study, and the detail of the work carried out by each member of the press gang, and the time and sequence of each operation. The shaded areas show the amount of "idle" time of each operator and Fig. 2 illustrates how, after analysis of all the data, it is possible to reduce the gang from six to five. This is the usual objective of such study, but charts of this nature are of value to the metallurgist for other purposes; they give information on times of operation, e.g. the time from procuring from the furnace to the time when extrusion commences, which when related to other factors such as temperature and pressure may be of critical importance.

One example of arriving at the best balance between two or more opposing factors is given by Passano[1]. The steel company with which he was associated frequently received orders for steel bars of a standard length with a small tolerance. Each bar was rolled from a billet of as near as possible constant weight; because of fluctuations in the size of billet, however, the actual as-rolled lengths of the final bar varied over several feet. A bar exceeding the required length had to be trimmed to size and the pieces cut off were unusable except as scrap for remelting; a short bar had to be scrapped completely. The manager of the bar mill made such a fuss over one bar too short that everyone "played safe" and, as Passano was able to show, caused a reduction in the overall yield of good material. He investigated the situation by measuring some hundreds of bars and plotting a frequency distribution of their length (Fig. 3).

This shows Passano's work in schematic form. The excess lengths of the bars are shown in descending order and the full line in the lower portion of the diagram is the result of plotting the frequency of occurrence of these excesses. It shows that there is an average waste of 1 ft. 8 in. arising from the trimming of over-length bars, equivalent to 4 per cent loss.

By deliberately reducing the length of the initial billet the frequency distribution shown by the dotted line is produced. In this case the loss is reduced to 3·4 per cent in total, although 1 per cent of the bars were completely scrapped because of their shortness. This illustration provides an example of the failure to balance regular losses against the more sensational losses involved in an occasional short length.

The next example is concerned with linear programming, which is applicable to processes subject to a set of linear restrictions with the need for ensuring that one overrides all the others. An obvious example is the selection of material for furnace charges—finding the least cost of raw materials of different compositions which, when melted together, will give a product of known weight and chemical composition. For simple problems in two variables with any number of constraints it is possible to have a graphical solution, and an example is given with materials of different impurity contents where it is desirable to find the cheapest proportions to

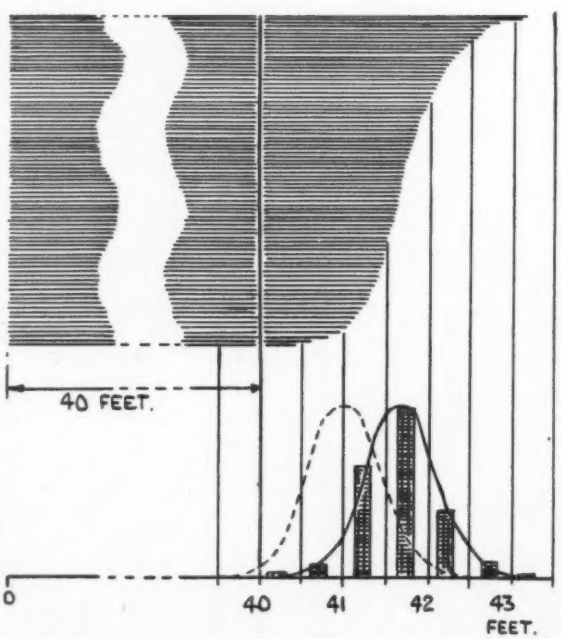


Fig. 3 — Frequency distribution of bar lengths (bars as-rolled). The dotted curve illustrates the result of reducing the average length by 8 in. One per cent of bars are now short of 40 ft. but the loss due to overlengths is much reduced

employ while still maintaining specification limits. Fig. 4 is a deliberately simplified example of how such a graphical solution is arrived at. Consideration of the data of the problem will show that in fact the solution can be deduced very simply without recourse to the graph, and such consideration will enable the principles of the method to be appreciated more readily, since verification is so easy.

Two raw materials are available, A and B, which can be considered as two available grades of, say, a metal like copper or zinc, or of an alloy such as brass, and their impurity limits are defined. In order to meet the specification requirement that no impurity element shall exceed 0·05 per cent the proportions of A and B which fulfil all the conditions must be found. The shaded area on the graph indicates the required range and is defined by drawing the limiting proportions for each element. For example, in the case of the iron (Fe) constituent it may be calculated that if this were the only element concerned the proportion of raw material B would be $\frac{0{\cdot}05 \times 100}{0{\cdot}09}$ lb. to give 0·05 per cent of iron in the final product. This is 55·5 lb. and so the first point on the ordinate of the graph is obtained. Similarly, with raw material A, the requirement $\frac{0{\cdot}05 \times 100}{0{\cdot}03} = 166{\cdot}6$ lb. would need to be met. Hence, there is a point on the abscissa of the graph. Since the relationship is linear these points can be joined and so define the area between this line, the abscissa and the ordinate which contains all the proportions of A and B which fulfil the conditions regarding the iron constituent alone. By similar calculations the areas can be defined within which the tin and lead requirements are met.

Obviously, the shaded area, which is common to all three elements, contains the required answer. Next the required weight is introduced, in this case 100 lb., by joining the appropriate points on the ordinate and abscissa. The answer must lie on this line within the shaded area, and since B is the cheaper constituent, must be at the point where B is at a maximum, i.e. on the edge of the shaded area. The cost element can also be introduced by drawing a line showing the proportions of A and B for a given cost. Quite arbitrarily £5 has been chosen for this but it could be any other amount. At 2s. 6d. per lb. £5 will purchase 40 lb. weight of constituent A—hence the point on the abscissa—and at 1s. 6d. per lb. the weight of constituent B will be 66 lb.—hence the point on the ordinate. Joining these points shows all the proportions of value £5. Since all cost lines are parallel to this line, a parallel can now be drawn which intersects the 100 lb. weight line within the shaded area at a cost of £10 16s. which is the minimum cost.

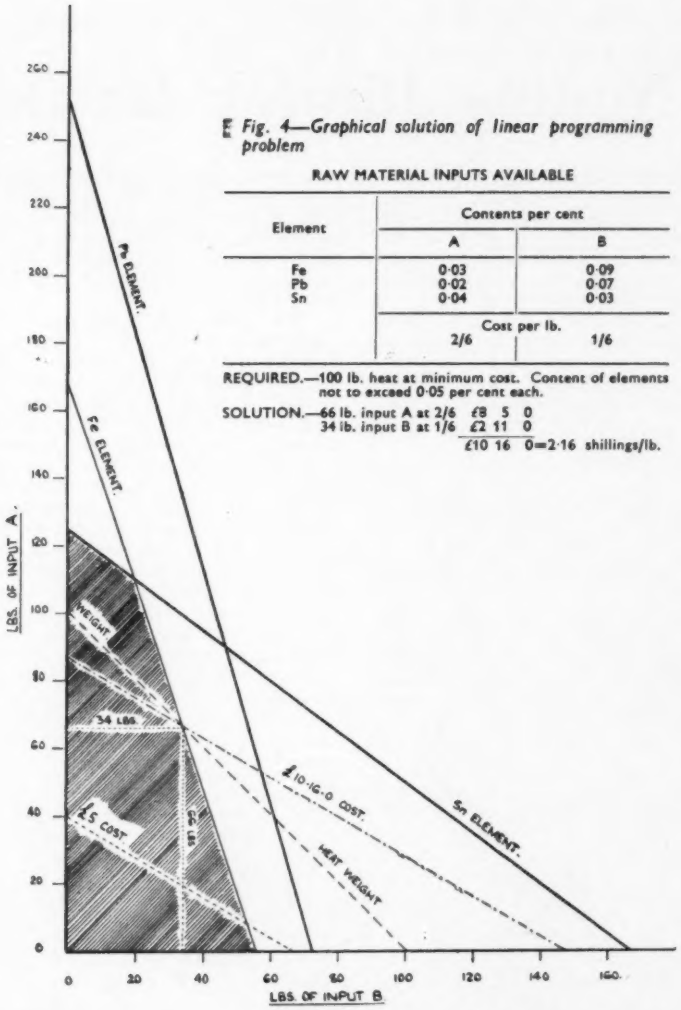


Fig. 4—Graphical solution of linear programming problem

RAW MATERIAL INPUTS AVAILABLE

Element	Contents per cent	
	A	B
Fe	0·03	0·09
Pb	0·02	0·07
Sn	0·04	0·03
	Cost per lb.	
	2/6	1/6

REQUIRED.—100 lb. heat at minimum cost. Content of elements not to exceed 0·05 per cent each.

SOLUTION.—66 lb. input A at 2/6 £8 5 0
34 lb. input B at 1/6 £2 11 0
£10 16 0=2·16 shillings/lb.

It will be appreciated that this answer can be obtained by the solution of a series of simultaneous equations, but the procedure is rather tedious. As long as there are only two variables a graphical solution can be used, but beyond that it is necessary to resort to algebraic procedures.

Reference

1 "American Iron and Steel Institute Year Book", 1949, p. 192.

Bearing Metals

FOR tests to evaluate the anti-friction properties of bearing alloys which were carried out in Russia and reported in *Vestn. Mashin*, a machine was developed in which increasing static load could be applied. The maximum specific bearing loads at the commencement of the steep rise in the friction coefficient were adopted as the final result of given tests, three bearing half shells from each class of material being tested.

Results revealed that the limiting load for the tin-Babbitt bearings at both rates of increase in loading employed, i.e. 2 and 15 kg/cm², was 360 kg/cm². The zinc-bearing alloy behaved differently from the remaining alloys tested in that its limiting load was higher at the faster loading rate than at the slower, viz 206 and 116 kg/cm² respectively. At a peripheral speed of 1·1 m/sec. for the bush journal, mean loading-capacity values for the different bearings were 360 kg/cm² for tin-Babbitt, 190 kg/cm² for lead-bronze, 110 kg/cm² for zinc alloy, 200 kg/cm² for phosphor bronze and 170 kg/cm² for antimony-bronze.

Tin-Babbitt, alongside zinc alloy, has high running-in ability, the best results from among the bronze alloys being achieved by the lead-bronze bearings. The coefficient of friction for all run-in bearing half shells tested, beginning from approximately 50 kg/cm², was 0·003-0·004.

INTERCHANGEABLE INSERTS AND CORE SLIDES AID ECONOMY

Nesting Die for Batch Production

DESIGNS for "nesting" dies for pressure die-casting are not essentially new, and interchangeable impression blocks have been used in the U.S.A. and elsewhere. However, nesting dies designed primarily for economies in batch production, and having impression blocks capable of being changed while the die is still on the machine platens, are a little more unusual. One such die, for the production of three components—the swivel body, fixed body and the wheel—for new sizes of the Shepherd castor (see METAL INDUSTRY, 16 September, 1955, p. 245) is described here. Long runs of any one set of components are not required, so that simple and rapid interchange of die impressions offers considerable economy.

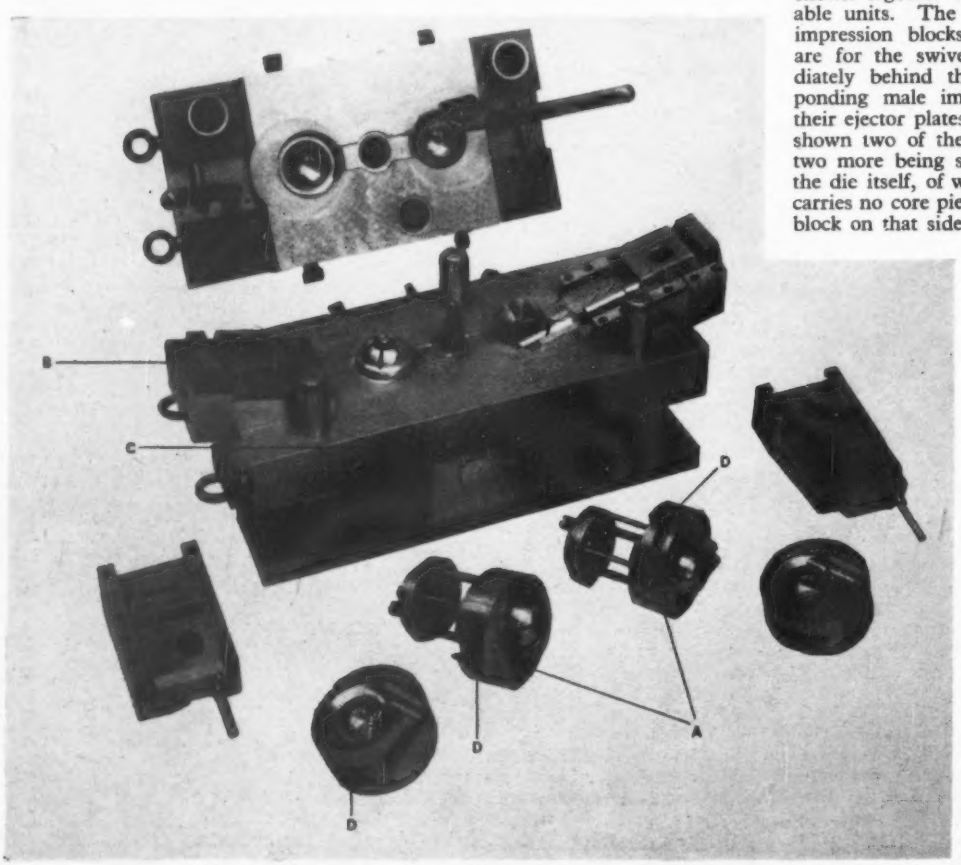
The die bolster has two circular recesses to take the impression blocks, the sides of the recesses having a slight taper. In these recesses the impression blocks are located, the tapered seating ensuring free release and absence of wear and scoring. To retain the impression blocks firmly against the seating, taper-ended bolts are tightened into recesses in the sides of the impression block. For extraction of the impression blocks, a tapered wedge tool or drift is used after the bolts have been withdrawn.

With each impression block is matched an ejector plate—a necessary measure since the three different components have differing ejector pin seatings—and the ejector plates are made so that they can be passed through the die block (for removal without taking the die from the machine). The ejector plates are secured by means of pegged shafts that have a tapered hole in the side. Into this hole a taper-ended screw is tightened to draw the ejector plate firmly against the die block.

In the case of the impression blocks for the castor wheel, the central core-pin is surrounded by an ejector sleeve that operates against the face of the central boss of the casting. Since the core-pin must be retained securely as the ejector sleeve slides along the pin, a forked plate is used under its head to retain it, while allowing removal from outside the die when impression blocks and ejector plates are changed.

Of the three components produced from the nesting die two require angular core slides. The angle of the slide differs for each of the components, and, further, in one pattern of castor a platform fitting is used and in the other a swivel pin is incorporated. Thus not only the impression blocks and ejector plates, but also the angular core slides have to be interchangeable. This has been achieved by making the core slide with a dovetail to accommodate a core piece suitable for producing either the platform or swivel fixing, and, for the slide in which the angle differs, the whole core slide block is removable from the die bolster, the securing bolts being accessible from the outside.

In the accompanying illustration, the die, which has been designed and made by Fox and Offord Ltd., in consultation with Archibald Kenrick and Sons Ltd., the users of the dies, is shown together with the interchangeable units. The two circular female impression blocks in the foreground are for the swivel body, and immediately behind these are the corresponding male impression blocks and their ejector plates. At either side are shown two of the angular core slides, two more being shown in position in the die itself, of which that on the left carries no core piece as the impression block on that side is for the wheel.



A—Impression block and ejector plate assembly
B—Angular core slide
C—Retaining bolts
D—Retaining slots

The die for the new range of Shepherd castors

Finishing Supplement

Progress in Polishing

FOUR Papers were presented at the recent one-day Symposium, held in London under the auspices of the Institute of Metal Finishing, which dealt with current developments in polishing, techniques and equipment. Of the four Papers, two were abstracted in our issue of 27 November, and abstracts of the other two are published here.

Chemical and Electrolytic Polishing

By F. H. WELLS

MANY metals can be polished by immersion in chemical solutions but, at the present time, the principal commercial use of chemical polishing is on aluminium, copper and their alloys. Most of the solutions used for this purpose are based on phosphoric acid. A gaseous phase process has been reported for stainless steel. The time of immersion of the metal in polishing solutions may be from 15 sec. to 5 min., but longer times are sometimes necessary.

Whilst the most commonly treated metals are aluminium and its alloys, with the exception of the high silicon casting alloys, copper alloys containing more than 63 per cent copper are also polished in this way. This category covers basis and cartridge brasses, gilding metals and nickel silver. Nickel and its alloys may be polished; for instance Monel and Ferry.

All alloys should preferably be single phase and lead-free. Bronzes (Si, Mn, Al and Sn), leaded brasses, stainless steel and mild steel cannot be chemically polished. These remarks apply to industrial practice. It is well-known that mild steel and stainless steel may be polished on the laboratory scale.

Other metals which have been polished chemically include titanium, beryllium, cadmium, germanium, lead, magnesium, tantalum, zirconium and zinc. Silicon has also been polished by chemical means, usually in nitric-hydrofluoric acid mixtures.

Chemical and electrolytic polishing have also been used for deburring, the preparation of sheet and forgings for inspection, and the reduction of foil to thicknesses not attainable by rolling practice.

Chemical and electrolytic polishing will affect fatigue strength only insofar as it may completely remove the compressively stressed Beilby layer when the polishing time is sufficiently prolonged. In practice, the time required to remove the layer depends on its thickness. This is influenced by the method and extent of the surface preparation.

There is no general theory of chemical polishing available, but there is a working hypothesis that fits the facts. This is concerned with film formation and dissolution.

When metals are immersed in acid mixtures, normally the metal dissolves and its surface becomes etched; with chemical polishing solutions this is not so. Chemical polishing could be defined as the dissolution of metals producing a smooth, bright surface without the formation of etch patterns. The process is also selective in that metal is removed from the elevations of the surface in preference to the depressions.

All chemical polishing solutions contain nitric acid or other oxidizing agents (H_2O_2 or CrO_3) and it has been suggested that nitric acid ennobles the metal surface, thus reducing the rate of metal dissolution.

This ennoblement may be due to film formation or gas adsorption. Film formation, or at least passivation of some kind, is supported by the experimental evidence from loss in weight-time curves for aluminium in various acid solutions.

All investigators agree that nitric acid or the oxides of nitrogen are essential to the process. The destruction of nitrite by the addition of urea to the bath prevents polishing taking place.

Although the mechanism of chemical polishing may involve film formation and dissolution, other features of the process must not be overlooked, particularly the properties of the viscous layer.

In phosphoric acid-based solutions the dissolution products are more viscous than the bulk of the solution; this viscous layer clings to the metal surface. In a short time this layer contains no more anions capable of joining with the metal ions, so that the rate of polishing is controlled by this "viscous barrier". An anion concentration gradient exists from the outer surface of the viscous barrier to the metal surface. The number of anions passing through this viscous barrier will be greater to the peaks than to the valleys because the viscous layer is thinner. The diffusion rate of the solution products is slow owing to the high viscosity and possibly to complex formation in these solutions.

Film formation and the viscous layer are important factors in the understanding of the electrolytic polishing process, but the existence of a higher current density on the peaks than in the troughs also creates a greater solution rate from the peaks. Furthermore, at a certain current : voltage relationship the metal becomes covered with an oxide film and polishing occurs, the rate of polishing being determined by the rate of film formation and dissolution. Film dissolution is a diffusion-controlled process.

A further factor in electrolytic polishing is the viscous layer that forms over the metal surface and is composed of metal dissolution products which may be complexed. There is a concentration gradient across the layer; the number of ions travelling to and fro in unit time is greater to the peaks than to the valleys. This results in a greater metal dissolution rate from the peaks.

Applications of these two groups of processes include chemical brightening, the simplest of all solutions which has been used for many years with metals such as brass, cadmium and zinc. The phosphoric acid-sulphuric acid mixture for use with aluminium will give bright lustrous surfaces on most grades of the metal. Chemical polishing solutions for aluminium are mainly either phosphoric/nitric/sulphuric acids or phosphoric/nitric/acetic acids.

All grades of aluminium can be polished in the phosphoric acid-based solutions, except the 2-13 per cent silicon casting alloys and aluminium containing lead or bismuth. The latter classification covers "free-cutting aluminium", but this is not very often used. Solutions based on phosphoric acid polish commercially pure and super-purity aluminium and their alloys with equally good results.

The cost of chemical polishing is very difficult to assess because drag-out will vary from one installation to another, but the following figures have been substantiated by production and laboratory experience: With a polishing time of 1 min. 345-390 ft^2 of surface may be polished per gall. of solution; with a 3 min. polishing time the figure is 80-135 ft^2. It must be mentioned here that the usual polishing period is between 1 and 2 min. for "new" solution and 3 to 4 min. for an "old" solution.

Solutions for copper alloys may be based on phosphoric acid with acetic and nitric acids. Sometimes sulphuric acid and hydrochloric acid are also added. An important patent specification for these solutions is U.S.P. 2,446,060, assigned to the Battelle Development Corporation, covering mixtures of phosphoric, nitric and acetic acids.

The metals that can be polished in

this type of solution are nickel silver, brasses, gilding metals, Monel and nickel. The results vary according to the metal being polished, the solution composition and the temperature.

The usual polishing time varies from 30 sec. to 5 min. at temperatures ranging from room temperature to 80°C. Improvement in the polishing of copper alloys occurs when either or both phosphoric and acetic acids are added to nitric-arsenic acid mixtures.

Chemical polishing of copper alloys is an economical technique when due consideration is given to the shape of the articles to be treated. This process is ideal for small articles of complicated shape or with an intricate embossed design on them; mechanical polishing would generally distort the pattern. It may often be advantageous to barrel-polish before chemical polishing to remove scratches and tool marks from the work. Large flat areas are best mechanically polished because they are easily and economically handled, particularly if the process is automatic. Chemical polishing gives a finish on curved surfaces equal to mechanically produced finishes; with articles of intricate design chemical polishing produces a better result.

Electrolytic polishing will treat a wider range of metals and alloys than may be chemically polished, but the materials treated commercially are stainless steel, copper alloys and aluminium alloys; other metals that could be treated with little trouble, are nickel, zinc, gold and silver.

Except for a few instances, the chemical polishing of aluminium has superseded the use of electrolytic polishing processes, mainly because good results have been much easier to obtain. Good results may also be obtained by the electro-polishing of copper and its alloy and the process is suitable for jewellery and other small articles.

Two processes for use with aluminium must also be mentioned; they are the Brytal and Alzak processes. They should be defined as "electro-brightening" rather than "electro-polishing" processes because so little metal is removed. These processes are mainly used on mechanically prepolished super-purity aluminium and will give really first-class results.

For both chemical and electrolytic processes pre-treatment is necessary to present clean, dry metal to the polishing bath; the way in which this object is reached does not matter. Usually, trichloroethylene vapour degreasing or alkaline soak cleaning is used. The latter is used in a mild steel tank heated by a mild steel steam heating coil. Fume extraction will be required to remove steam.

After cleaning, a water rinse will be used and then a desmudging stage if the metal being treated is aluminium. This is to remove copper and other metals not dissolved during alkaline cleaning. Desmudging may be followed by cold and hot water rinsing; the latter to assist drying. Cold water rinses are best contained in white PVC-lined mild steel tanks; the desmudging solution is 50 per cent by volume nitric acid and may be used in a PVC-lined or stainless steel tank.

Chemical polishing solutions containing nitric acid must be used in tanks made from 18/8 stainless steel to which has been added 3 per cent of molybdenum to confer a degree of hot acid resistance and some weld stability. This same material may be used for electropolishing solutions containing chromic acid; phosphoric acid-sulphuric acid solutions will attack 18/8 stainless steel at about 70°C., but this is prevented by the addition of chromic acid. This is automatically added if stainless steel is being polished.

Lead-lined mild steel tanks should be used for chemical brightening solutions and may be used for phosphoric acid-sulphuric acid type electropolishing solutions.

Recent Development in the Field of Barrel Finishing

By C. J. KELLARD

PRE-PLATE finishing is still the most difficult result to obtain consistently and economically, if capital equipment costs, installation costs, effluent disposal, etc., are all considered. Studies and experiments over the last four years have resulted in the development of the single submerged and automated submerged systems of barrelling.

In the submerged system of barrelling, an octagonal barrel, which is perforated with a series of small holes along each barrel flat, is suspended in a lined tank filled with chemical compound, the complete barrel assembly being designed so that at will it can be raised and lowered into the tank to facilitate loading and unloading.

During the initial experiments with prototype equipment a number of problems arose. The first sections of the barrel were made of perforated steel plate. It was found that this restricted the use to parts of simple geometry. Parts having projections, small lugs, or thin pointed sections, became lodged in the steel perforated plate, resulting in serious damage. After considerable experiment with a variety of materials the barrel sections were made of perforated rubber or Neoprene moulded sections ½ in.-¾ in. thick.

To reinforce this rubber section, a perforated steel backing plate is entered into the mould during manufacture of the section, thereby giving the rigidity and load factor required. Since the barrel is submerged, special bearings and lubricant were developed to give trouble-free operation. Over long periods of operation suspended in the tank, the compound solution after a few days' use becomes "loaded" with abrasive abraded from the media, and, therefore, standard roller or ball type bearings were unsuitable for this condition.

Once the equipment details had been solved, tests were carried out to determine the best type of media and compound combination possible. Results showed that normal compounds as used in closed barrels did not have sufficient "life" for use in submerged equipment, and that the general type of barrelling media, i.e., granite, limestone or aluminium oxide chips, did not have sufficient cutting action to undertake fast surface cut down in the minimum of time. (Since the barrel is perforated it is not possible to use an abrasive compound because the abrasive particles "wash out" and settle on the tank bottom.) A new type of chip was developed having a large crystal structure with greater density to compensate for the mass weight loss due to immersion. This medium proved very successful in giving a regular cutting action, producing an exceptionally fine surface of good colour, and is easily converted into a burnishing medium by using a burnishing compound of pure sodium oleate and calcium sulphate.

Workload tests over a period of one year show that this method is completely reliable, and the resultant finish and colour considerably exceed that of conventional type closed equipment and have, in fact, in certain instances proved superior to parts finished by hand polishing, even under production conditions. It must, of course, be emphasized that the same limits apply as in normal closed type barrelling in that parts weighing more than 4 to 5 oz. and exceeding 6 in. in length cannot be processed in workload quantities to give a polished surface free of defects without using a fixture technique.

Where a surface cut down is required before burnishing, it is undertaken in the one cycle, using the same medium, simply moving the barrel assembly through two tanks, each charged with the appropriate compound, thereby eliminating completely labour time involved in unloading, reloading, etc., as in conventional closed type equipment, the parts not being touched until completely finished.

One of the most important results of this investigation was to prove that stainless steel and the nickel alloys can be finished by barrelling to a very high standard. This group of metals has always proved difficult to treat satisfactorily by conventional closed barrels requiring considerable process control and observation. In the submerged method no special approach or technique is required.

So far, the use of the submerged process for finishing preparatory to electroplating only has been discussed. Since the surface finish produced is generally of the order of 10 to 2 micro

in., its application to engineering requirements gives the production engineer a new tool in obtaining superfine surface finishes equal to that produced with expensive machine tools such as grinding and honing machines. The metal removal rate is uniform in relation to time, therefore a wider tolerance is possible in machining prior to finish grinding or honing; it is, therefore, possible to eliminate the third grinding pass saving an operation, at the same time the cost per piece to produce a surface of 10 to 2 micro in. is reduced by 97 per cent with reference to engineering costs using machine tools of the type mentioned.

The usual types of media employed are generally of random shape as produced by crushing the crude material. Since these "chips" are not uniform in size and dimension, problems arise with regard to chip lodgement in components having slots and recesses. Considerable research has been undertaken in producing pre-shaped media within a close tolerance so that by careful choice of dimension it is now possible completely to eliminate this problem.

These pre-shaped chips have also been developed to serve both processes, i.e., using the submerged or closed type barrelling process. Two basic types are available in a range of seven sizes which, though slightly more expensive, yield production economies that generally outweigh the high initial cost.

Another media development has been the production of various steel shapes to eliminate "shadowing" experienced in burnishing where only steel balls or spheres were used.

There are, however, still a vast number of components which, due to geometry, specification or weight, will not tolerate tumbling either by conventional or submerged type processes, and for these two types of equipment, the Spindle machine and the Vibrasheen process, have been developed.

The Spindle machine consists of a number of spindles which can be lowered individually into a trough containing media with a suitable compound, the trough being turned at a peripheral speed of 300-600 ft/min. The component is attached to the spindle and then lowered into the revolving trough of media, the components being turned on the axis of the spindle while travelling around the tub immersed in the mass.

High capital costs make the Spindle machine satisfactory only where the volume and type of components are such that the machine can be utilized fully. It is, therefore, essential that a full investigation be undertaken before deciding on this type of equipment.

A further development is a vibratory method for intricate components requiring a good finish in recessed areas.

The equipment consists of a very rugged frame into which a tub is fitted, being located on coil springs with longitudinal stabilizers. Media, compound, water and components are then loaded into the tub, and the tub is then vibrated at the required frequency and amplitude to give a scouring and finishing action on the surface of the part.

The action that takes place is semi-rotary throughout the tub contents, whereas with normal barrelling the action is in the sliding layer motion imparted as the barrel is turning. Because of this, the vibratory motion has an improved metal removal rate compared with normal barrelling. Since the component itself is also in motion the recessed areas fill up with media allowing action to take place within the restricted area. There is, however, a limit to the hole or bore sizes which can be treated successfully by this method, hole sizes or slots below $\frac{1}{16}$ in. width or diameter and deeper than $\frac{1}{2}$ in. cannot be finished satisfactorily since the aperture does not permit a continuous flow through and action is lost due to flow restriction. A high surface finish is somewhat difficult to obtain with reliability to a standard of duplication as required under production conditions.

On cost analysis the overall cost of operating the vibratory type process is slightly more than the closed type barrel. Although workload to media ratio is higher in the vibratory process, the labour handling time in undertaking ancillary operations in cleaning, separating, handling, etc., is much higher.

A further point is that media depreciation is much higher compared with conventional barrelling, this being due to the vibratory action being imparted throughout the mass load. The depreciation rate when reflected against amount of metal removed shows a 15 per cent higher loss rate comparing conventional barrelling with vibratory action. The advantages with the vibratory method, therefore, are the process is somewhat faster, certain parts can now be treated which defied solution by normal barrelling, and, therefore, the range of components that can be deburred or finished by mechanical methods is further widened.

Precision Plating

A PRECISION hard chrome plating unit known as the Veriform Process Plating Unit, Model 100, has been introduced by Coventry Gauge and Tool Co. Ltd., Fletchamstead Highway, Coventry. This equipment will plate up to 50 in^2 of surface area at a time but larger units can be designed to suit individual requirements. All ancillary equipment can be supplied.

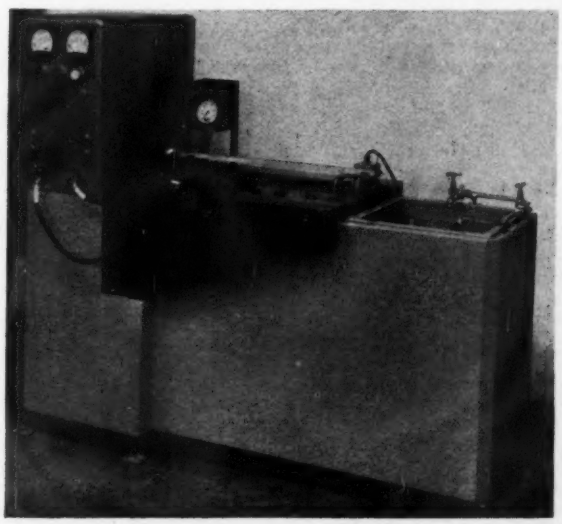
The Veriform process enables a predetermined plate thickness to be controlled to 0·0001 in. Thus, hard chrome plating can be carried out on small precision components, rendering them highly resistant to wear and corrosion.

A special chrome plating solution is used which, in conjunction with carefully controlled timing, temperature and current density, deposits a hard skin of chromium well bonded to the base metal. In the case of highly polished components, deposits can be applied with no loss in micro finish.

Except for cleaning the work no preliminary separation to plating is necessary.

Some features of the Veriform process are: Closer control of plate thickness eliminating costly grinding and lapping operations; high throwing power enabling grooves and shoulders to be plated with clean sharp corners; high ductility and close bonding.

The Model 100 unit shown in the accompanying illustration is very compact, being only 5 ft. long. A generous exhaust system is provided and the extraction system is designed to suit users' individual requirements.



The Veriform hard chrome plating unit

Correspondence

Correspondence is invited on any subject considered to be of interest to the non-ferrous metal industry. The Editor accepts no responsibility either for statements made or opinions expressed by correspondents in these columns

Export of Scrap

TO THE EDITOR OF METAL INDUSTRY

SIR,—I am very glad that the half-yearly meeting of the National Association of Non-Ferrous Scrap Metal Merchants at Birmingham was successful, and that such a lively discussion ensued. From this the erroneous impression might easily be gained that merchants dealing in non-ferrous scrap are acutely dissatisfied with the consumers in this country with whom they are dealing. This could create an undercurrent of tension between consumer and merchant and should this continue it will be far from conducive to the atmosphere of good feeling and mutual confidence which must necessarily exist between supplier and consumer in this country.

So far, we have only heard the voices of those who feel that they must export at all costs. But a large number of merchants are quite content to supply the consumers in this country, realizing how much they depend on the use of scrap. Let me, at this juncture, add that naturally the abolition of restrictions is universally desired, but this must be effected at the right time, as judged by the Government, which is in full possession of the facts.

Reference was made during the meeting to the alleged high profit made by ingot-makers, but many merchants, who themselves have no cause for complaint, have no reason to object to the prosperity of the consumer. Reports of these high profits are exaggerated as the ingot trade is known to be highly competitive.

Constant pleading with the Board of Trade for the abolition of restriction on the export of non-ferrous scrap will make us as unpopular with the authorities as we potentially are with the consumers, as the goodwill of both these bodies is essential to us, since we constitute merely a part of the metal trade in its entirety. Merchants who also deal in ferrous scrap form a substantial part of the trade and have only asked the Government to export when material could not be sold in this country—and indeed, their request was granted. (They could also have made out a case for export, as prices abroad for ferrous material are higher.)

Merchants should rather concentrate their endeavours on requesting consumers to finance the establishment of a research panel, whose object would be to investigate the more extensive and effective uses of scrap. This panel would be to their ultimate advantage, as eventually the export of scrap would be permitted, and they will be ready to compete with consumers abroad on equal terms, having discovered that non-ferrous scrap can be utilized in an extensive variety of new uses. This in turn might bring in its wake *import* of scrap.

Assuming that the Government suddenly changed its policy regarding the export of scrap owing to pressure on the part of the merchants, it should not be forgotten that foreign Governments have a habit of altering their import regulations. A time may come when we have to fall back on consumers in this country, who by this time may well have made other arrangements to cover their needs, and there would be no outlet left for scrap.

Yours, etc.,

S. Sternberg,
Managing Director,
F. C. Larkinson Ltd.
132/134 Grafton Road,
London, N.W.5.

Reader's Digest

ZINC

"Zink - Taschenbuch" ("A Handbook on Zinc"). *Published by Metall-Verlag G.m.b.H., Berlin-Grunewald, for Zinkberatung e.V. Pp.* 380. *Price DM.* 19·50.

SO varied are the applications to which zinc and its compounds are put, it follows that any attempt to condense the technology of this metal into a single book will inevitably deal but briefly with some aspects of the subject. In spite of this, this handbook on zinc does compress a wide range of information into a relatively small space.

Its contents include a chapter on zinc statistics, giving mine production, smelter production, secondary zinc production and zinc consumption. In the second chapter, a brief history is given, together with an outline of zinc mining, zinc ores and their distribution, smelting and reduction processes, electrolytic zinc and refining.

The metallurgy of zinc and its alloys is discussed in chapter III, and analysis and testing are dealt with in chapter IV. In chapter V, melting and founding are covered, the various methods, i.e. sand and chill casting, pressure die-casting, etc., each having a separate section devoted to them. Chapter VI is a review of semi-fabricating processes, rolling, pressing, etc., and typical uses of the product are described. A brief chapter (chapter VII) covers drilling, boring, turning, and similar machining operations. The anti-corrosion properties of zinc are discussed at some length in chapter VIII, and various systems of protective coating are described. In chapter IX, compounds of zinc (zinc oxide, lithopone, etc.), are briefly dealt with, and the subject of chapter X is electroplating upon zinc and its alloys. The remaining two chapters deal with joining techniques and German standards.

Obituary

Mr. D. J. O. Brandt

WE regret to record the death of Mr. D. J. O. Brandt, metallurgical editor of *Metal Treatment and Drop Forging*. After obtaining a B.Sc. in Metallurgy at the Royal School of Mines, he joined Murex Limited, leaving in 1942 for the Ministry of Supply. After the war he went to John Miles and Partners (London) Limited, and later joined the British Iron and Steel Research Association as a senior scientific officer in the steelmaking division. He left B.I.S.R.A. in 1955 to practice independently as a metallurgical consultant, and joined Industrial Newspapers Limited in 1957. He was a Fellow of the Institution of Metallurgists and a member of the Iron and Steel Institute and the Institute of Metals.

Mr. James L. Chalmers

IT is with regret that we also have to record the death, at the age of 69, of Mr. J. L. Chalmers, chairman of E. Chalmers and Company Ltd., of Leith. He was the son of the founder of the firm and, after an apprenticeship with a Leith company, he joined his father's firm, becoming a director, and then managing director in 1927. He had been at various times President of the National Association of Non-Ferrous Scrap Metal Merchants, of the Scottish Scrap Iron and Steel and Metals Association, while he also served on the Joint Scrap Advisory Committee throughout the last war. He served in the Royal Flying Corps during the first world war and was awarded the Military Cross. He commanded the Edinburgh and South East Scotland Wing of the Air Training Corps during the last war and was awarded the M.B.E. for his services.

Mr. J. Shearer

WE also regret to record the death of Mr. James Shearer, head of Shearer Bros. (Metal Merchants) Ltd., of Bridgeton, Glasgow. Educated at Allan Glens and at the Royal Technical College, Glasgow, he joined the family firm in the metal trade.

Industrial News

Home and Overseas

A Century of Metal Broking

An interesting book with the above title has just been published by **Vivian, Younger and Bond Ltd.**, who have completed 100 years of trading in London. The book tells the story of a start from small beginnings, the difficult periods through which the concern has passed, its efforts during the wars, and the development and expansion from what was originally a small partnership to what is to-day an integral part of a large organization.

The book tells the story of the supply of metals, principally of tin, the formation of the London Metal Exchange, and the ultimate formation of the British Metal Corporation which, together with Henry Gardner and Co. Ltd., comprise the Amalgamated Metal Corporation, with all its many interests in the world of non-ferrous metals.

Much of the history is concerned with one man, Sir Cecil Lindsay Budd, K.B.E., who, during his lifetime, played a very important part in the development of the non-ferrous metals trade. It is a story, too, of development in other fields, such as the establishment of a trading concern in Nigeria, associations with Cornwall, Malaya, Australia, and of many other parts of the world.

On Tuesday of last week the chairman and directors of Vivian, Younger and Bond Ltd. entertained a number of personalities in the industry in their board room at Princes House, London, on the occasion of the publication of this book.

A Removal

News from **Geo. W. Neale Ltd.**, solder manufacturers, is to the effect that they have transferred their works and offices from Bermondsey, London, S.E., to a new sales office at Plantation House, Mincing Lane, London, E.C., and to new works premises at Manor Metal Works, Harrow Manor Way, London, S.E.2.

Area Office in Cardiff

In the light of the present and future industrial importance of the South Wales area, the **Incandescent Group of Companies** has opened an area office at 40 Newport Road, Cardiff, under the management of Mr. J. W. Payne.

The group includes the Incandescent Heat Co. Ltd., Metalectric Furnaces Ltd., Controlled Heat and Air Limited, and Selas Gas and Engineering Ltd.

Aluminium Roofing in Scotland

Over one million sq. ft. of Rigidal corrugated aluminium sheeting, a product of the **British Aluminium Company Ltd.**, has been used for the cladding of the new Scotch whisky warehouses and cask store of the Distillers Company Ltd., at Carsebridge, Scotland.

The 30 warehouse bays, each approximately 30,000 sq. ft. in floor area, are covered by 260 tons of 20 s.w.g. Rigidal 10½/3 in. pitch corrugated sheeting in 28 ft. 9 in. lengths. A further 40 tons of aluminium was used for flashings, ventilators, etc. This is one of the largest expanses of aluminium in the country. A wall cladding introduced by The British Aluminium Company in June 1959, 20 s.w.g. Rigidal Seamwall, is being used on the cask store in lengths between 6 ft. 3 in. and 16 ft. 6 in., but lengths of up to 40 ft. can be supplied, and above that length by special arrangement.

Aluminium was selected for the roofing of these steel-framed buildings as it is light and durable and, therefore, easy to handle and erect; it needs no painting and withstands industrial and marine atmospheres; but it was the ability of aluminium to reflect rather than to absorb the heat of the sun—thus giving the even temperature needed for Scotch whisky maturation—that was the deciding factor for choosing aluminium for this new and very important project.

An Order from Norway

In the face of severe competition from the Continent, the Heavy Plant Division of **Associated Electrical Industries** has secured a contract from Norway for a 108,000 kW rectifier installation required in connection with aluminium smelting. This rectifier equipment is believed to be the largest of its kind yet ordered.

The contract has been placed by Ardal og Sunndal Verk, the equipment being for important extensions to their existing plant at Ardal—situated at the head of the Sognefjord, on the west coast of Norway. A/S Ardal og Sunndal Verk are already the largest producers of aluminium in Norway, and the new extensions represent an increase in production capacity of 32,000 tons per annum. The order covers semiconductor rectifier equipment rated at 135,000 amp., 800 V D.C., and the plant is to be commissioned and in commercial operation early in 1962.

Spray Finishing

A problem frequently met in spray finishing is that of feeding to the spray gun a material which is heavily pigmented, and which readily settles out when not being used. **Alfred Bullows and Sons Ltd.**, having encountered this problem in their own production, have solved it, and offer to others the simple and inexpensive solution.

The Bullows "Pogo" pump is used to feed the material through a standard fluid hose to the spray gun, to which is attached a "Y" piece. From this piece a second length of hose provides a return flow to the pump, and thence to the container of material, which is itself kept agitated by this constant flow and return of material.

This very simple arrangement has now been operating for just over 18 months, running day and night, and the company says it is possible to pick up the gun and spray filler at any time, without any stoppage at all. This new pump will, it is said, pump from a mixing or storage tank, or can even be mounted on the existing pressure feed container if this is preferred. The equipment operates off the existing air line, using less than 3 ft^3/min. of air at pressures as low as 30 lb/in^2.

New London Office

In order to give a better service to their customers in the London area, the **East Sussex Engineering Co. Ltd.**, of Lewes, have now opened an office at 270 Upper Tooting Road, London, S.W.17, with the telephone number Balham 3136.

The Physical Society

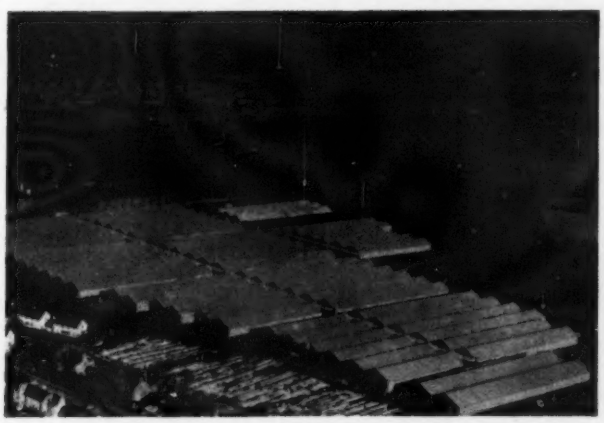
From Monday, January 18, until Friday, January 22, next year, the Physical Society Exhibition of scientific instruments and apparatus will be held at the Royal Horticultural Society's Old and New Halls, Westminster, London, S.W., and the opening ceremony will be performed in the New Hall on the first day, at 11 a.m., by Mr. J. A. Ratcliffe, C.B.E., M.A., F.R.S., President of the Society.

During the first three days, demonstration-lectures will be given at 5.45 p.m. Special admission tickets are not required for these.

Postgraduate Courses

A residential course on "The Mechanics of Metal Forming" has been arranged at the **University of Liverpool** from March 27 to April 1 next year. This course is specifically designed as an introduction to the theoretical and experimental study of metal forming. A knowledge of strength of materials to Higher National Certificate standard is assumed, although appropriate revision will be included when required. The course should appeal to people in industry and to lecturers in Colleges of Technology.

Resident students will be accommodated in Derby Hall, a University Hall,



One of the largest expanses of aluminium. The new warehouses and store for the Distillers Company Limited, at Carsebridge

for a fee of £15 15s. 0d. inclusive of residence and tuition. Non-resident students can be accepted for a fee of £10 10s. 0d., which includes dinner on the opening evening, and lunch on other days. Full details from the Director of Extra-Mural Studies at the University.

Aluminium in Building

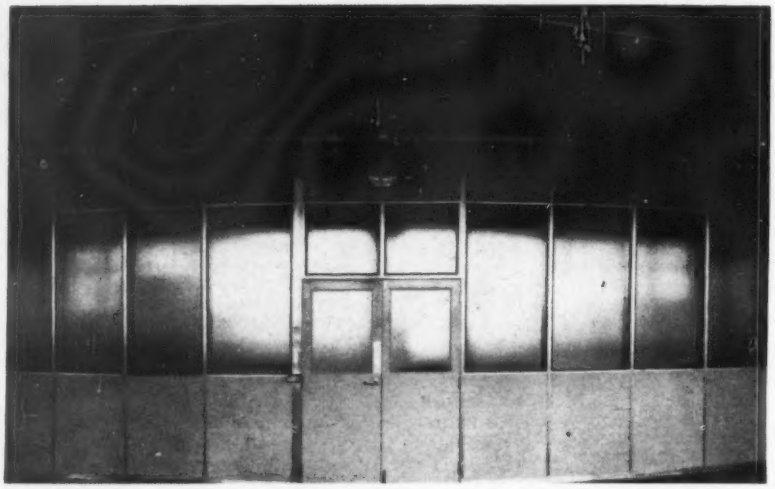
Bold, long-sighted planning has resulted in the work of the North West Gas Board's Accountancy Division being centralized in an attractive and unusually-shaped modern single-storey building at Altrincham, Cheshire. The main part of the building is based on an eleven-sided geometrical figure, with an open light well in the centre, and it was planned particularly to combat fatigue and distractions which can arise in a highly mechanized accounting office. The space in the central light well is designed as a courtyard with paving of hexagonal slabs and shingle, and with a fountain and pond.

Aluminium was used extensively in a variety of applications that make the most of its inherent advantages of strength and durability, while its light, clean appearance adds greatly to the pleasant aspect which the building presents. The circular building is clad on the exterior with "Wallspan" aluminium curtain walling, supplied by Williams and Williams Ltd., and fixed between concrete columns at about 10 ft. 6 in. centres. White and grey panels of Muroglass were used for infillings, and these tone well with the aluminium sections of Noral 50SWP (BS.1476:HE9WP) alloy. To improve the insulation properties of the infill panels, insulation board was added with a ½ in. dead air space between the panels. There are no opening lights in the curtain walling owing to the air-conditioning system, each fast light being fitted with an aluminium-slatted Venetian blind, aluminium blind box and aluminium window sill.

The office wing is fitted with purpose-made aluminium windows, fixed between concrete columns at 3 ft. 6 in. centres, with infill panels of white and grey Muroglass and insulated board. In order to accommodate the unusual thickness into the window sections, an aluminium angle sub-frame was added to the sections to give sufficient rebate depth. The interior glass-and-hardboard partitions, supplied by Unilock Limited, are framed with aluminium extrusions in Noral B51SWP (BS.1476:HE10WP) alloy.

The patented Unilock principle of slotting horizontal aluminium members into vertical members enabled the partitions to be formed into the curved corridor required by the radius of the building. The partitions were sound-insulated by double-glazing, and a special dado panel, made up of a combination of perforated plastics sheets, plaster-board and glass-fibre quilts, provided the very high decibel reduction required. A special vertical box section member, with a snap-on cover plate, was incorporated for wiring runs and switch and power points. In sections of the corridor, the dado panels are decorated in a variety of pleasing colours.

A special skirting board incorporating ducting for the electrical wiring, designed by Unilock Limited in conjunction with Mr. Norman Blezard, M.I.H.V.E., A.M.C.T., was fabricated from extruded aluminium sections supplied by **Northern Aluminium Company Limited** (whose material was also used in several of the applications mentioned). The ceilings throughout are of aluminium acoustic tiles, supplied and fitted by Frenger Ceilings Limited, London, and these incorporate aluminium ventilation louvres. The building is earthed by a lightning conductor fabricated from extruded aluminium flat bar.



An interior view showing the curved aluminium-frame partitions, and the aluminium acoustic ceilings, at the North West Gas Board's Electronic Accounting Centre at Altrincham

Expansion Programme

As a result of recent substantial building improvement programmes, the two Manchester firms — **Brayshaw Furnaces Limited** and **Brayshaw Tools Ltd.** — are now able to meet the increasing demands which are being made upon both firms for their products.

Although housed at the same address, both companies now have spacious office accommodation, while the tremendous developments which have been effected in the works and other departments, with the considerable improvements also in space layout and plant, have already showed significant results.

Old Railway for Scrap

A contract for the demolition of the world-famous Swansea to Oystermouth Railway has been awarded to **Thos. W. Ward Limited.** This railway is stated to be the oldest passenger carrying railway in the world, but on January 5 next year the last veteran car and its trailer will make its last trip, after which the demolition men move in.

Science in Industry

Our leading article this week (page 405) deals with the third of a series of reports written for the Science and Industry Committee of the British Association. It is published as a book by the Oxford University Press at the price of 21s. net. The authors are Mr. G. F. Carter and Mr. B. R. Williams, and the contents cover 186 pages. After an introduction, the work is divided into two sections as follows:—Part 1: Action by Industry, and Part 2: Action by Government.

Airmec Exhibition

It is announced that the annual Airmec Exhibition is to be held next year from January 18 to 22 at its usual venue, Napier Hall, Hide Place, Vincent Square, London, S.W.1. Admission is by ticket only, and these are obtainable free of charge from **Airmec Limited,** High Wycombe, Bucks. The exhibition will, as usual, show the full range of the company's electronic instruments and industrial control equipment, and representatives of the company will be in attendance to take enquiries and demonstrate any instrument.

A London Meeting

On Thursday next, December 17, members in the London area of the **Association of Bronze and Brass Founders** will hold a meeting at the Clarendon Restaurant, Hammersmith, W.6, at 2.30 p.m. The meeting will be preceded by a Christmas luncheon.

Gift to University

It is understood that the University of Birmingham has accepted the offer from **Joseph Lucas Limited** to finance a Fellowship in the field of metal joining in the department of industrial metallurgy for seven years.

A Chair of Welding

At the annual dinner of the Birmingham branch of the **Institute of Welding,** held last week, the President of the Institute, Mr. E. Seymour-Semper, suggested that as Birmingham University had shown its awareness of modern problems in proposing a Chair in Road Engineering, it could also be the first university to set up a Chair of Welding. He said that this country was lagging behind in education in welding compared with Russia and the United States.

Taking the Work to the Men

Owing to the increasing demand from both home and export markets for Jones mobile cranes, **K and L Steelfounders and Engineers Ltd.,** a member of the George Cohen 600 group of companies, are to expand their engineering division. A long lease has been arranged for one of the Board of Trade factories at Newburn - on - Tyne, situated on the Newburn Trading Estate. It has a floor area of 24,000 ft², and is complete with all power, lighting, heating, and other services, and has a two-storey office block.

Due to the great shortage of skilled

engineering personnel in the Letchworth area, and in conformity with Government policy, this expansion has been planned to take the work to where men are available. It is expected that a start will be made there in the next few weeks with a dozen or so machines, and a gradual build-up will continue through next year.

125 Years

Some three weeks ago in these columns we included a note relating to the fact that **George Cohen Sons and Company Limited** were celebrating their 125th birthday. The company has now published "The 125 Year Book of 600", which contains 125 humorous drawings and cartoons which they consider to be among the funniest that have appeared in their "600" magazine. Also contained in this book is a section detailing the companies of the 600 Group, illustrating their products, activities, and the services they provide, and what, in general, they do to earn a living.

A Birmingham Event

For its annual dinner-dance this year, on Thursday of last week, **The Non-Ferrous Club** once again gathered at the Chadwick Manor Hotel, Knowle. Some 170 members and guests attended this function, which proved to be a very happy occasion.

Among the guests were Miss Noele Gordon and Mr. Philip Dorté, of A.T.V., both of whom have been recent guest speakers at the club's monthly luncheon meetings. A novel feature of the evening was that a voucher for a "hair-do" was given to each lady present.

German Tinplate Industry

Speaking at the sixth annual German tin conference, held at Düsseldorf on Thursday of last week, Dr. W. E. Hoare, assistant director of the **Tin Research Institute,** praised the technological and economic development of the German tinplate industry. In his opening lecture to the conference, Dr. Hoare referred to a number of notable German tinplate plants, and said they were operating with commendable success. Dr. Hoare's Paper dealt with the electrodeposition process in the manufacture of tinplate. Another speaker was Mr. S. C. Britton, head of the electrochemistry and corrosion department of the Tin Research Institute.

Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week fell 208 to 7,977 tons, comprising London 4,666, Liverpool 3,021, and Hull 290 tons.

Copper stocks fell 805 to 5,897 tons, distributed as follows:—London 1,374, Liverpool 2,948, Birmingham 75, and Manchester 1,500 tons.

A Safety Periscope

A new piece of optical equipment has been added to the range of remote and indirect viewing equipment produced by **P. W. Allen and Company,** who are specialists in lighting and optical equipment for visual inspection and observation in industry and research.

This safety periscope, as it is called, is for the use of observers when closely viewing equipment and processes through sight glasses in pressure vessels, furnaces, chemical plants, etc., who may be in great danger of serious injury in the event of window breakage. Using this new periscope, the observer can stand well clear of the window in a safe zone and yet have his "eye" right up to the sight glass.

Low voltage high intensity spotlights are also available to fit on the end of the device for such uses as when viewing equipment inside pressure vessels which are without internal lighting. The periscope is supplied complete with fitted wood carrying case. We understand that delivery is approximately seven weeks for standard units.

Men and Metals

It has been announced that the following members have been elected to fill vacancies on the Council of The Institute of Metals, with effect from the annual general meeting to be held in March next year:—As President, **Sir Ronald Prain,** O.B.E., Hon. M.I.M.M. (chairman and President, Rhodesian Selection Trust Ltd.). As vice-presidents, **Dr. H. M. Finniston,** B.Sc., Ph.D., A.R.T.C., F.I.M. (research manager, C. A. Parsons and Sons Ltd.), and **Mr. H. W. Hignett,** B.Sc., F.R.I.C., F.I.M. (assistant managing director, Henry Wiggin and Co. Ltd.). As ordinary members of Council, **Dr. R. W. K. Honeycombe,** M.Sc., Ph.D. (Professor of Physical Metallurgy, University of Sheffield); **Dr. Ivor Jenkins,** D.Sc., F.I.M. (chief metallurgist, Research Laboratories, The General Electric Co. Ltd.), **Mr. E. Robson** (managing director, The Manganese Bronze and Brass Co. Ltd.), **Mr. J. Salter,** B.Sc., A.M.I.E.E. (director, The British Aluminium Co. Ltd.), and **Mr. Christopher Smith,** F.I.M. (works director, James Booth and Co. Ltd.).

Until recently managing director of Hermann Kaufmann Limited, **Mr. Hermann Kaufmann** has joined the board of B. O. Morris (Holdings) Limited, of Coventry. Mr. Kaufmann is also a director of Herka Investments Ltd., Phoenix Appliances Ltd., and Eugene Ltd.

To increase their technical representation in Scotland, Sir W. H. Bailey and Co. Ltd. have appointed **Mr. R. N. Bartley** as their North Eastern Counties representative, and to be responsible for Scotland also.

To succeed the late Mr. James L. Chalmers, **Mr. George MacDonald** has been elected chairman of E. Chalmers and Co. Ltd. **Mr. Richard Anderson, Mr. C. R. Dunford** and **Mr. H. G. Shields** have been appointed joint managing directors of the company.

At the end of this present year, **Mr. A. Noel Smith, Mr. H. F. Smith** and **Mr. Ernest Leete,** all of whom have served the London Electric Wire Company and Smiths Limited for varying periods as joint managing directors, will be retiring after an association in each case of over fifty years. Mr. A. Noel Smith was appointed to the board in 1909 and elected chairman in 1953, which position he held until 1957, when he was succeeded by the present chairman, **Mr. E. L. Wildy.** The first secretary of the present company, Mr. Leete was appointed to the board in 1912. In 1914, Mr. H. F. Smith was appointed a director of the company, and from that date until 1934 he was responsible for purchasing the company's copper supplies. Since then, while retaining his seat on the board, he has been a consultant of the company.

At the last meeting of the Institute of Physics, the following were elected as Fellows of the Institute:—**Mr. A. F. Brown, Mr. R. W. Cahn, Mr. A. J. Goss, Mr. R. Heastie,** and **Mr. K. W. Keohane.** In addition, 41 Associates, 56 Graduates, 79 Students, and 2 Subscribers were elected.

In succession to **Col. B. H. Leeson,** who has resigned, **Mr. J. O. Knowles,** a director of Metal Industries Limited, has been elected chairman of the British National Committee of the International Electrochemical Commission.

On Monday of last week, **Mr. A. A. B. Harvey** was inducted as President of the Institute of Metal Finishing for the ensuing year by **Dr. T. P. Hoar,** the retiring President.

Forthcoming Meetings

December 15 — Institute of British Foundrymen. Slough Section. Lecture Theatre, High Duty Alloys Ltd., Slough. "Running and Gating of Castings." W. W. Glick. 7.30 p.m.

December 15—Institute of Metal Finishing. South West Branch. Royal Hotel, Bristol. Open Forum. 7.30 p.m.

December 16—Powder Metallurgy Joint Group of The Iron and Steel Institute and The Institute of Metals. Hoare Memorial Hall, Church House, Great Smith Street, London, S.W.1. Symposium on "The Powder Metallurgy of Magnetic Materials".

December 16—Powder Metallurgy Joint Group of The Iron and Steel Institute and The Institute of Metals. 17 Belgrave Square, London, S.W.1. Informal Conversazione (tickets required).

December 16 — Institute of Metals. London Local Section. Joint Meeting with London Branch of the Institute of British Foundrymen. The Constitutional Club, Northumberland Avenue, London, W.C.2. "Aluminium Castings." J. Vickers. 7 p.m.

December 17—Institution of Mining and Metallurgy. Rooms of the Geological Society, Burlington House, Piccadilly, W.1. General Meeting. 5 p.m.

December 17—Institution of Production Engineers. Scottish Region. The Institution of Engineers and Shipbuilders, 39 Elmbank Crescent, Glasgow, C.2. "Welding and Marine Engineering." J. A. Dorrat. 7.30 p.m.

December 17—Association of Bronze and Brass Founders. Clarendon Restaurant, Hammersmith, London, W.6. Meeting at 2.30 p.m., preceded by luncheon at 12.30 p.m.

Metal Market News

THE nett result last week of the waiting period for tin was that cash lost £2 10s. 0d. at £793, while three months closed £2 down at £791. The turnover was 600 tons. Well after hours last Friday evening it was announced by the International Tin Council that the export quotas of producing members of the Tin Agreement should total 36,000 tons for the first quarter of next year. This shows an increase of 6,000 tons on the total for the present quarter, and compares with 25,000 tons in the third quarter. Probably the news came as something of a surprise to the trade, for the U.S. demand since the steel workers resumed operations has been disappointing. It was announced that the amount of tin in the Buffer Stock at the end of June last was 13,990 tons, but it must be presumed that there has been a substantial reduction since then. Otherwise the quota would hardly have been raised to 36,000 tons. By common consent, the tonnage held by the Buffer Pool Manager is now less than 10,000 ton, and this would not look very large if the steel dispute in the United States were satisfactorily settled and a vigorous demand for the metal released in consequence. Fears of any shortage of tin should now be resolved and the backwardation eliminated. L.M.E. warehouse stocks were 475 tons up at 8,185 tons. Friday's movement in copper prices exemplified the state of affairs at present existing in this metal, for while cash advanced £2 5s. 0d. to £253, the forward quotation, under pressure of sales, dropped by £1 10s. 0d. to £237, the turnover for the day being heavy at 3,275 tons. These, then, were the closing quotations in a week when values advanced steadily in spite of some spasms of hesitation and weakness on the New York futures market. Once again consumers and others have exhibited alarm over the scarcity of metal likely to be encountered in the New Year, and buying was encountered both in this country and on the Continent. A fillip to bull sentiment was given by the news in midweek that there was no fear of a renewal of the longshoremen's strike in the States, for this, of course, clears the way for the export of copper to America. With the copper strike still not settled, this pointed to a continuing call for early delivery, and since L.M.E. stocks were reported 150 tons lower at 6,702 tons, it is not surprising that demand centred on the cash position. On the other hand, there was a tendency to sell ahead, for it must be assumed that by March the worst of the shortage will be over. The turnover for the week was about 9,000 tons, cash registering a gain of £15 10s. 0d. and three months of only £3 5s. 0d. These details give some idea of how sentiment has developed.

The prolonged delay in reaching a settlement in the U.S. copper strike is certainly very disappointing, and as we write it certainly looks as though the dispute might drag on for some weeks yet. The loss of production has been very great, and in these circumstances one certainly cannot visualize any cutback in output by the producers for several months to come. One of these days doubtless that will happen, but it will be necessary first to build up the supply line. There is nothing of special importance to report about either lead or zinc, and price changes in these metals were relatively unimportant. On a turnover of about 6,500 tons, December lead finished 7s. 6d. up at £71 10s. 0d., while March was 2s. 6d. lower at £71 15s. 0d. Some 6,000 tons of zinc changed hands, December closing 15s. down at £94 15s. 0d., while March was 5s. lower at £89 15s. 0d.

Birmingham

The steady progress which has been made in the metal-using industries seems likely to continue. The consumer goods trade have been leading in the general revival, but heavy engineering industries are rapidly catching up, and it is believed that their position will show a solid expansion early next year. Record sales are being made in the electrical industries as far as domestic appliances are concerned. One of the biggest firms in the heavy electrical business plans to build a new factory in the Midlands to cope with the demand for its products. Trade in plumbers' brassfoundry has improved steadily during the year. At least one Birmingham firm is placing orders for additional plant and buildings.

Demand for iron and steel is expanding steadily, but, because of the recession in the early part of the year, it is unlikely that this year's total output will exceed that of 1958. Sheet makers are under heavy pressure to supply cold reduced sheets to the motor trade. There are more enquiries for steel for constructional engineering, and the output of plates is growing steadily. Makers of steel tubes have replenished their order books, and the outlook is much brighter than it looked in the first half of this year. There is no shortage of pig iron, despite the fact that demand for iron castings has expanded considerably. The steel re-rolling mills continue well employed and delivery dates for most classes of finished steel have been extended. The market for soft billets is tighter.

New York

Commodity Exchange copper was steady in a fair trading volume at the week-end. Physical copper was quiet and prices remained unchanged. Fair nearby business in tin was reported, which dried up on the International Tin Council announcement of an increase of 6,000 tons in exports for the first quarter of 1960. Traders here said they agreed with London sources that an increase of 6,000 tons might have a bearish effect on the market, although they said it might take some time for the producing countries to reach that additional figure. Lead was quiet. Prime western zinc was moderately active. In the closing stages, tin was quiet and about steady; lead, zinc and copper were unchanged.

Although it expects an increase in fourth-quarter earnings from its steel strike-slashed third-quarter net, Kaiser Aluminium and Chemical Corporation's net income for this year would be less than in 1958, Mr. D. A. Rhoades, President, told Dow Jones. For the third quarter, the aluminium producer had net of 2,014,000 dollars, or five cents a common share. This was off sharply from the first six months this year, when earnings totalled 13,222,000 dollars, or 72 cents a share. The Kaiser Aluminium and Chemical President said he anticipated an increase in both sales and earnings next year, however. This, he stated, was prompted by what the company expected to be an industry-wide production increase in 1960 of from seven to ten per cent from present levels. "We expect to get our proportionate share of this increase", Mr. Rhoades declared.

Tin consumption in the United States remained virtually unchanged in September 1959, according to the Bureau of Mines, United States Department of the Interior. Tin used during the month totalled 4,825 long tons and comprised 2,150 of primary pig tin and 2,675 of secondary and imported tin-base alloys. August consumption of tin was 4,760 long tons, 2,185 of primary and 2,575 of secondary and imported tin-base alloys. In September, brass mills used 130 long tons of tin (75 of primary pig tin and 55 of secondary pig tin and scrap). August consumption was 110 tons, comprising 80 of primary and 30 of secondary.

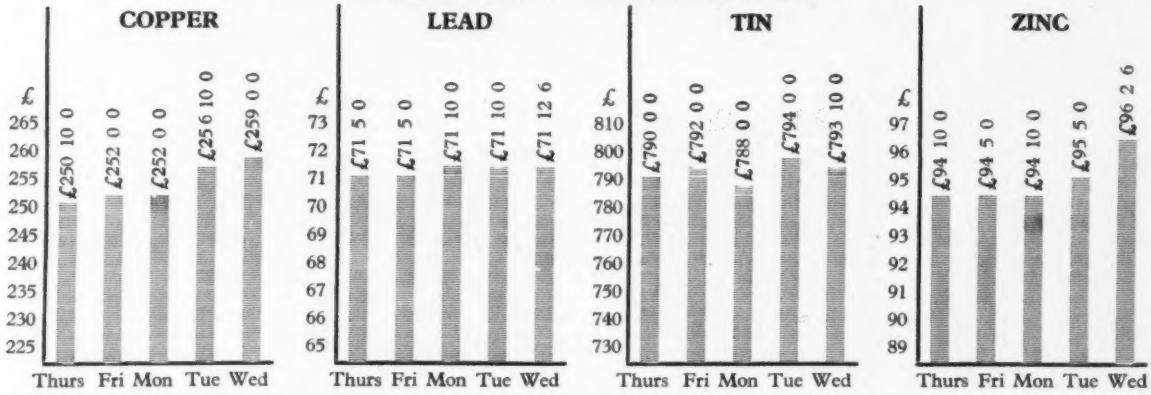
New Zealand

News from Wellington is to the effect that Mr. Walter Nash, the Prime Minister, met three Australian representatives of Consolidated Zinc Pty. for discussions on the establishment of an aluminium smelting works in South Island, using lakes Manapouri and Te Anau as hydro-electric power sources. Mr. Nash said the Government was not yet ready to sign an agreement with the company, and that the terms of agreement were still under consideration. The Prime Minister said that when full agreement was reached the project would be submitted to the Cabinet for final decision.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 3 December to Wednesday 9 December 1959



Primary Metals

All prices quoted are those available at 2 p.m. 9/12/59

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	6
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite	per unit		—	
Copper H.C. Electro	ton	259	0	0
Fire Refined 99·70%	„	258	0	0
Fire Refined 99·50%	„	257	0	0

		£	s.	d.
Copper Sulphate	ton	77	0	0
Germanium	grm.		—	
Gold	oz.	12	10	7
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	71	12	6
Magnesium Ingots	lb.		2	0
Notched Bar	„		2	9½
Powder Grade 4	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal	ton	245	0	0
Mercury	flask	72	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	8	10	0
Platinum	„	28	10	0
Rhodium	„	41	0	0
Ruthenium	„	18	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	8¼
Tellurium	lb.		18	0
Tin	ton	793	10	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	93	3	9
Dust 95/97%	„	126	0	0
Dust 98/99%	„	132	0	0
Granulated 99+%	„	118	3	9
Granulated 99·99+%	„	136	1	3

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton	**Canada** c/lb ≏ £/ton	**France** fr/kg ≏ £/ton	**Italy** lire/kg ≏ £/ton	**Switzerland** fr/kg ≏ £/ton	**United States** c/lb ≏ £/ton
Aluminium		22.50 185 17 6	224 168 0	375 221 5	2.50 212 10	26.80 214 10
Antimony 99.0			230 171 10	450 265 10		29.00 232 0
Cadmium			1,300 975 0			130.00 1,040 0
Copper						
Crude				485 286 2 6		
Wire bars 99.9 Electrolytic	33.25 244 17 6	30.00 247 17 6	342 256 12 6		3.00 255 0	33.00 264 0
Lead		10.75 88 12 6	103 77 5	166 98 0	.91 77 7 6	13.00 104 0
Magnesium						
Nickel		70.00 578 5	900 675 0	1,200 708 0	7.50 637 10	74.00 592 0
Tin	108.50 798 17 6		1,100 825 0	1,500 885 0	9.75 828 17 6	100.62 805 0
Zinc						
Prime western		12.75 105 7 6				
High grade 99.95		13.35 110 5 0				
High grade 99.99		13.75 113 12 0				
Thermic			130.00 97 10 0			
Electrolytic			138.00 103 10 0	206 121 12 6	1.20 102 0	14.00 112 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 9/12/59

		£	s.	d.
Aluminium Alloy (Virgin)				
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0
Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	172	0	0
B.S. 1490 L.M.2	„	185	0	0
B.S. 1490 L.M.4	„	192	0	0
B.S. 1490 L.M.6	„	200	0	0
***Aluminium Bronze**				
BSS 1400 AB.1	ton	252	0	0
BSS 1400 AB.2	„	260	0	0
***Brass**		£	s.	d.
BSS 1400-B3 65/35	ton	165	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	217	0	0
***Gunmetal**				
R.C.H. 3/4%	ton	„		
(85/5/5/5) LG2	„	206	0	0
(86/7/5/2) LG3	„	215	0	0
(88/10/2/1)	„	257	0	0
(88/10/2/½)	„	271	0	0
***Manganese Bronze**				
BSS 1400 HTB1	„	199	0	0
BSS 1400 HTB2	„	215	0	0
BSS 1400 HTB3	„	229	0	0
Nickel Silver				
Casting Quality 12%	„	245	0	0
„ „ 16%	„	250	0	0
„ „ 18%	„	270	0	0
***Phosphor Bronze**				
B.S. 1400 P.B.1. (A.I.D. released)	„	306	0	0
B.S. 1400 L.P.B.1	„	228	0	0
Phosphor Copper		£	s.	d.
10%	ton	260	0	0
15%	„	262	0	0
Phosphor Tin				
5%	„		—	
Silicon Bronze				
BSS 1400-SB1	„	262	0	0
Solder, soft, BSS 219				
Grade C Tinmans	„	369	10	0
Grade D Plumbers	„	297	5	0
Grade M	„	405	10	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
B.S.S.1004 Alloy A	ton	129	6	3
B.S.S.1004 Alloy B	„	133	6	3
Sodium-Zinc	lb.		2	8½

**Average prices for the last week-end.*

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

		£	s.	d.
Aluminium				
Sheet 10 S.W.G.	lb.		2	8½
Sheet 18 S.W.G.	„		2	10½
Sheet 24 S.W.G.	„		3	1½
Strip 10 S.W.G.	„		2	8½
Strip 18 S.W.G.	„		2	9½
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2½
Circles 18 S.W.G.	„		3	1½
Circles 12 S.W.G.	„		3	0½
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11½
Tubes 1 in. o.d. 16 S.W.G.	„		4	1
Aluminium Alloys				
BS1470. HS10W.				
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3½
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2½
Strip 24 S.W.G.	„		3	10½
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9½
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9½
BS1477. HPC15WP.				
Plate heat treated	„		6	3½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0½
BS1476. HE10WP.				
Sections	„		3	1½
Brass				
Tubes	„		2	0⅝
Brazed Tubes	„		3	2½
Drawn Strip Sections	„		3	3⅛
Sheet	ton	221	0	0
Strip	„	221	0	0
Extruded Bar	lb.		2	1⅞
Extruded Bar (Pure Metal Basis)	„		—	
Brass				
Condenser Plate (Yellow Metal)	ton	206	0	0
Condenser Plate (Naval Brass)	„	217	0	0
Wire	lb.		2	10½
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Copper				
Tubes	lb.		2	5⅝
Sheet	ton	286	15	0
Strip	„	286	15	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	303	5	0
Cupro Nickel				
Tubes 70/30	lb.		3	7⅞
Lead				
Pipes (London)	ton	111	10	0
Sheet (London)	„	109	5	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	lb.		3	10⅞
Wire 10%	„		4	5½
Phosphor Bronze				
Wire	„		4	3¼
Titanium (1,000 lb. lots)				
Billet 4½″ to 18″ dia.	lb.	54/-		55/-
Rod ½″ to 4″ dia.	„	95/-		62/-
Wire ·036″-·232″ dia.	„	167/-		110/-
Strip ·003″ to ·048″	„	200/-		75/-
Sheet 8′ × 2′. 20 gauge	„	85/-		
Tube, representative average gauge	„	300/-		
Extrusions	„	105/-		
Zinc				
Sheet	ton	130	10	0
Strip	„	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 8/12/59.

	£
Aluminium	
New Cuttings	151
Old Rolled	135
Segregated Turnings	108
Brass	
Cuttings	175
Rod Ends	162
Heavy Yellow	131
Light	125
Rolled	165
Collected Scrap	126
Turnings	152
Copper	
Wire	228
Firebox, cut up	215
Heavy	210
Light	205
Cuttings	228
Turnings	205
Braziery	171
Gunmetal	
Gear Wheels	185
Admiralty	185
Commercial	173
Turnings	168
Lead	
Scrap	61
Nickel	
Cuttings	—
Anodes	550
Phosphor Bronze	
Scrap	173
Turnings	168
Zinc	
Remelted	86
Cuttings	73
Old Zinc	53

Financial News

Yorkshire Copperworks (Holdings)

Final dividend 6 per cent on capital increased by one-for-two scrip issue, making a total equivalent of 10 per cent for year to July 31, 1959 (same). Consolidated profits combining the figures for the company with one-half of the profits of Yorkshire Imperial Metals amount to £1,100,702 (£973,545) before tax £646,466 (£410,910). Tax figures are distorted owing to special circumstances arising out of the formation of Yorkshire Imperial Metals.

Shell Chemical Co. Ltd.

This company has announced price reductions of up to £9 per ton, effective on December 1 last, on the following products:—Methyl Ethyl Ketone, Methyl Isobutyl Ketone, Secondary Butyl Alcohol, and Methyl Isobutyl Carbinol.

Tube Investments Ltd.

In his statement to the stockholders, the chairman of the company, Sir Ivan A. R. Stedeford, K.B.E., makes reference to the notable event of the year, the passing of the control of the British Aluminium Co. Ltd. into that of T.I. Ltd. He also said that there are welcome signs that the recession which hit the world's aluminium industry some two years ago is becoming less severe, but it is likely to be quite a time yet before the considerable over-capacity is taken up.

Trading profits of the company for the year to July 31 last, after depreciation, were £12,617,000, just about the same as the year before. This year, however, seven months' trading profits of the British Aluminium Company and Reynolds T.I. Aluminium are included. If adjusted for comparison as near as possbile, there would be a reduction of about 10 per cent below the record figures of last year; this resulted from reduced turnover and margins.

Wolverhampton Diecasting Co.

Chairman of the company, Mr. W. C. Sproson, reports that, early last year, demand fell away because the motor industry was changing over to new models. Later on, demand revived, and to the end of the year, June 30 last, the company's production capacity had been taxed to the utmost. So far this year, demand has been well maintained and, in view of expansion plans of the motor industry, Mr. Sproson thought demand from that industry would increase still further.

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Haywood (Coleshill) Limited (640384), Park Works, Birmingham Road, Coleshill, Warwicks. Registered October 26, 1959. To carry on business of manufacturers of and dealers in light alloy castings, pressings and stampings, general engineers, etc. Nominal capital, £2,000 in £1 shares. Directors: Bernard J. Haywood and Mrs. P. A. Haywood.

Metal Recoveries (Newhaven) Limited (640559), West Quay, Newhaven. Registered October 27, 1959. Nominal capital, £1,000 in £1 shares. Directors: Marlene Newton-Smith and Michael Newton-Smith.

Wordsley Diecasting Company Limited (641102), Sutton Street, Wordsley, near Stourbridge. Registered November 3, 1959. Nominal capital, £1,500 in £1 shares. Directors: Samuel Mole, Mrs. Maude Mole and Mrs. Gwendoline M. Barnett.

Walter Hicks Limited (641220), 235 Summer Lane, Birmingham, 19. Registered November 4, 1959. To carry on business of scrap merchants, metal and machinery merchants, etc. Nominal capital, £2,000 in £1 shares. Directors: Walter H. Hicks and Mrs. A. Hicks.

H.G. Die Casting Co. Limited (641252), 54 Gamage Building, 118-122 Holborn, E.C.1. Registered November 4, 1959. Nominal capital, £100 in £1 shares. Director: Helmut Gorden.

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (francs per kilo):		
Electrolytic copper scrap	(£210.0.0)	280
Heavy copper	(£210.0.0)	280
No. 1 copper wire	(£198.17.6)	265
Brass rod ends	(£142.12.6)	190
Zinc castings	(£68.2.6)	91
Lead	(£63.17.6)	85
Aluminium	(£135.0.0)	180
Italy (lire per kiio):		
Aluminium soft sheet clippings (new)	(£200.15.0)	340
Lead, soft, first quality	(£80.17.6)	137
Lead, battery plates	(£45.10.0)	77
Copper, first grade	(£233.0.0)	395
Bronze, commercial gunmetal	(£180.0.0)	305
Brass, heavy	(£156.7.6)	265
Brass, light	(£141.15.0)	240
Brass, bar turnings	(£147.12.6)	250
Old zinc	(£54.5.0)	92

Japan (Yen per metric ton):		
Electrolytic copper	(£—)	335,000
Copper wire No. 1	(£—)	295,000
Copper wire No. 2	(£—)	250,000
Heavy copper	(£—)	295,000
Light copper	(£—)	240,000
Brass, new cuttings	(£—)	210,000
Red brass scrap	(£—)	223,000
West Germany (D-marks per 100 kilos):		
Used copper wire	(£216.2.6)	247
Heavy copper	(£214.17.6)	243
Light copper	(£157.0.0)	190
Heavy brass	(£127.7.6)	145
Light brass	(£92.10.0)	105
Soft lead scrap	(£57.10.0)	65
Zinc scrap	(£48.2.6)	55
Used aluminium unsorted	(£105.2.6)	120

Trade Publications

S.G. Iron.—The Mond Nickel Company Limited, Thames House, Millbank, London, S.W.1.

Another publication in the series dealing with the development of S.G. Iron describes in detail the properties and a number of important applications. These, together with many tables and other information should be of much value to designers and metallurgists.

Box Type Furnaces.—Metalectric Furnaces Ltd., Cornwall Road, Smethwick, 40, Staffs.

A new leaflet of four pages deals with this company's standard box type furnaces, which have been developed for a wide variety of heat-treatment processes and basically for operating temperatures up to 1,000° C. Statistics and photographs are included.

Epoxide Resins.—Bakelite Limited, 12-18 Grosvenor Gardens, London, S.W.1.

A booklet entitled "Bakelite Epoxide Resins and Their Applications" outlines some of the uses of the comprehensive range of epoxide systems marketed by this company. The booklet is intended for use in conjunction with the large number of advance information sheets and technical memoranda already issued on specific applications of Bakelite epoxide systems.

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for August, 1959, have been issued by the Ministry of Supply as follows (in long tons):—

Virgin Aluminium	
Production	2,060
Imports	23,821
Despatches to consumers	25,998
Secondary Aluminium	
Production	6,684
Virgin content of above	661
Despatches (including virgin content)	7,000
Scrap	
Arisings	9,300
Estimated quantity of metal recoverable	6,622
Consumption by:	
(a) Secondary smelters	8,245
(b) Other uses	990
Despatches of wrought and cast products	
Sheet, strip and circles	10,672
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,197
(b) Tubes (i) extruded	233
(ii) cold drawn	489
(c) (i) Wire	1,533
(ii) Hot rolled rod (not included in (c) (i)	2
Forgings	266
Castings: (a) Sand	1,392
(b) Gravity die	3,874
(c) Pressure die	1,447
Foil	1,375
Paste	240
Magnesium Fabrication	
Sheet and strip	6
Extrusions	44
Castings	139
Forgings	6

THE STOCK EXCHANGE

Renewed Support For Steel Shares

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 7 DECEMBER	+RISE — FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	31/3	—3d.	9	9	5 15 3	33/3	23/3	24/9	17/6
400,000	2/–	Anti-Attrition Metal	1/3		4	8¼	6 15 0	1/6	1/3	1/9	1/3
41,303,829	Stk. (£1)	Associated Electrical Industries ...	58/9	—1/3	15	15	5 2 3	67/–	54/–	58/9	46/6
1,613,280	1	Birfield	67/—	—6d.	15	15	4 9 6	75/–	46/9	62/4½	46/3
3,196,667	1	Birmid Industries	104/9	—3d.	20	17½	3 16 6	108/9	72/–	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	67/–	+1/9	12½	11	3 14 6	67/–	36/1½	39/–	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/9		5	5	6 7 0	16/3	15/–	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	20/–		6	6	6 0 0	20/–	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	45/-		10	10	4 9 0	45/–	27/6	28/9	24/–
300,000	1	Ditto Pref. 5%	15/–		5	5	6 13 3	15/6	14/–	16/–	15/–
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6		7	7	6 16 6	20/6	20/–	20/4½	19/–
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	20/9		6	6	5 15 9	20/9	18/9	20/–	18/4½
17,247,070	Stk. (£1)	British Insulated Callender's Cables	54/6	+6d.	12½	12½	4 11 9	61/–	46/3	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	76/-	—6d	10	10	2 12 9	79/6	49/3	52/–	28/3
1,200,000	Stk. (5/–)	Canning (W.) & Co.	15/6		25+ *2½C‡	25	4 0 6	16/9	12/3	25/3	19/3
60,484	1/–	Carr (Chas.)	2/–	+1½d.	12½	25	6 5 0	2/10½	1/3	2/3	1/4½
555,000	1	Clifford (Chas.) Ltd.	28/–	+1/–	10H	10	7 2 9	28/–	22/6	22/–	16/–
45,000	1	Ditto Cum. Pref. 6%	16/9		6	6	7 3 3	17/–	15/3	16/–	15/–
250,000	2/–	Coley Metals	3/9	+3d.	15	20	8 0 0	4/–	2/10½	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	73/9	+3/6	15	18¾	4 1 3	75/9	59/–	65/3	41/–
1,509,528	1	Davy & United	110/3	+5/3	30‡	20	2 14 6	111/9	43/1½	87/–	45/9
6,840,000	5/–	Delta Metal	24/3	+3d.	31‡	30	3 4 0	26/6	12/–	25/–	17/7½
5 296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	52/9	—6d.	15	12½	5 13 9	60/–	36/7½	38/–	22/9
750,000	1	Evered & Co.	42/–	+5/–	10§	15D	4 15 3	42/–	30/–	30/–	26/–
18,000,000	Stk. (£1)	General Electric Co.	43/6	—3d.	10	10P	4 12 0	48/9	30/–	40/6	29/6
1,500,000	Stk. (10/–)	General Refractories Ltd.	45/–	—1/3	20	20	4 9 0	46/3	31/9	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	66/9xd		16½	15	4 19 3	67/–	63/–	67/6	61/–
750,000	5/–	Glacier Metal Co. Ltd.	10/6	+3d.	11½	11½	5 9 3	10/6	6/7½	8/3	5/–
1,750,000	5/	Glynwed Tubes	25/6	—6d.	20¶	20	3 18 6	26/3	16/4½	18/1½	12/10½
5,421,049	10/–	Goodlass Wall & Lead Industries ...	47/6	—9d.	13‖	18D	2 14 9	49/6	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	117/6	+2/6	30	20	5 2 0	117/6	75/–	57/9	45/–
396,000	5/–	Harrison (B'ham) Ord.	25/3		*17½	*15	3 9 3	26/3	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6		7	7	7 3 6	19/6	19/3	19/9	18/4½
1,075,167	5/–	Heenan Group	15/–	—1/–	15	10	5 0 0	15/9	7/6	9/7½	6/9
246,209,422	Stk. (£1)	Imperial Chemical Industries ...	54/–	—9d.	12 DZ	10	2 19 3	58/9	33/9	38/–	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	17/6xd	—1/–	5	5	5 14 3	18/10½	16/–	17/1½	16/–
14,584,025	**	International Nickel	191	+3	$3	$2.60	2 16 6	193	154½	169	132‡
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/4½	16/9	15/–
6,000,000	1	Ditto Ord.	47/6		12D	10	3 7 3	49/–	29/7½	47/–	36/6
600,000	10/–	Keith, Blackman	32/6	—1/3	17½E	15	5 7 9	33/9	25/–	28/9	15/–
320,000	4/–	London Aluminium	7/4½xd	+3d.	10	10	5 8 6	8/3	5/3	6/–	3/–
765,012	1	McKechnie Brothers Ord.	60/9	+9d.	15F	[illegible]	4 18 9	63/9	41/–	45/–	32/–
1,530,024	1	Ditto A Ord.	59/3	+6d.	15F	15	5 1 3	62/–	38/9	45/–	30/–
1,108,268	5/–	Manganese Bronze & Brass	16/9		20⅝	20	5 19 9	18/6	13/9	14/1½	8/9
50,628	6/–	Ditto (7½% N.C. Pref.)	6/3	+3d.	7½	7½	7 4 0	6/3	6/-	6/3	5/6
13,098,855	Stk. (£1)	Metal Box	79/6	+2/3	11	11	2 15 3	80/–	44/7½	73/3	40/6
415,760	Stk. (2/–)	Metal Traders	9/6	—6d	50	50	10 10 6	12/3	8/4½	9/–	6/3
160,000	1	Mint (The) Birmingham	35/–	+6d.	10	10	5 14 3	35/–	22/–	22/9	19/–
80,000	5	Ditto Pref. 6%	80/–		6	6	7 10 0	80/–	69/–	83/6	69/–
5,187,938	Stk. (£1)	Morgan Crucible A	50/9	—3d.	10ϕ	10	2 16 3	51/6	30/7½	45/–	34/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	18/6		5½	5½	5 19 0	18/6	17/6	18/–	17/–
2,200,000	Stk. (£1)	Murex	62/3	—1/6	15	17½	4 16 6	63/9	41/–	58/9	46/–
468,000	5/–	Ratcliffs (Great Bridge)	13/6	—6d.	10R	10	2 15 6	13/6	9/6	11/1½	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	55/-		25	20	4 11 0	55/–	27/9	27/3	24/6
1,365,000	Stk. (5/–)	Sirck	20/3xcap	+3d.	17½GB	15	2 17 6	30/9	18/–	18/7½	11/–
6,698,586	Stk. (£1)	Stone-Platt Industries	60/–	—3d.	15	15	5 0 0	63/–	42/6	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	17/9		5½	5½	6 4 0	18/3	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord.	122/–	+2/9	20	17½	3 5 6	122/3	72/–	86/–	48/4½
41,000,000	Stk. (£1)	Vickers	32/6	+3/4½	10	10	6 3 0	37/–	27/4½	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	16/–		5	5	6 5 0	16/–	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	24/–		*5	*5	6 3 0A	24/-	20/6	23/–	21/3
2,200,000	1	Ward (Thos. W.), Ord.	153/9	—3/9	25	20	3 5 0	157/6	83/–	87/3	70/9
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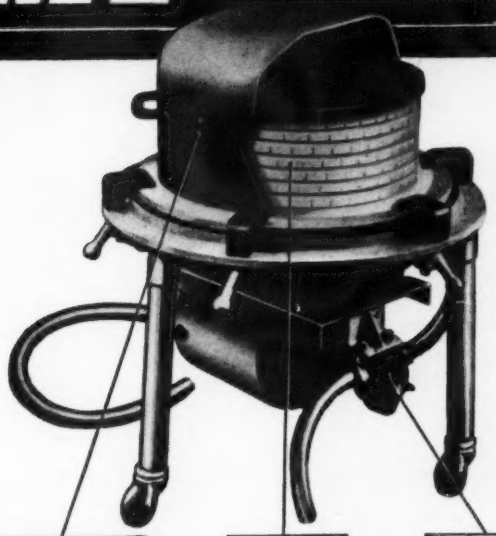

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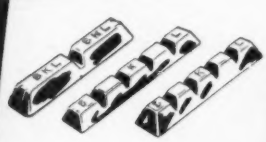

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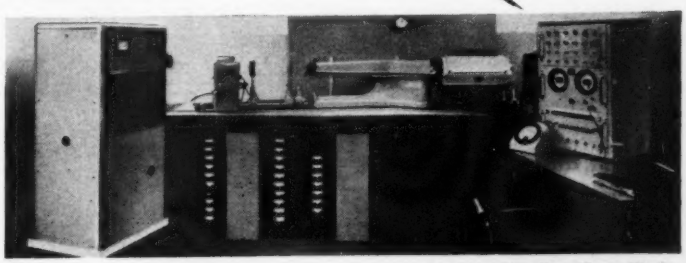

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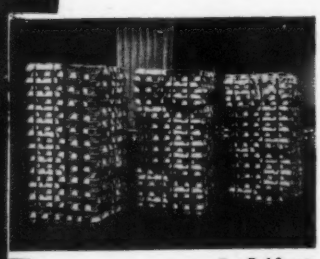

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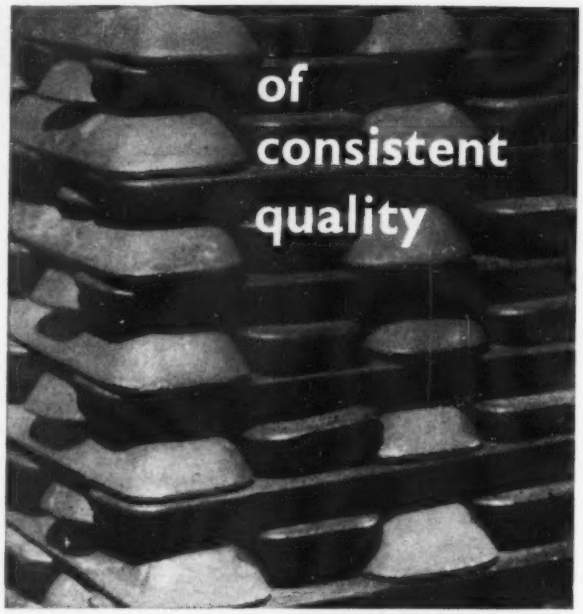

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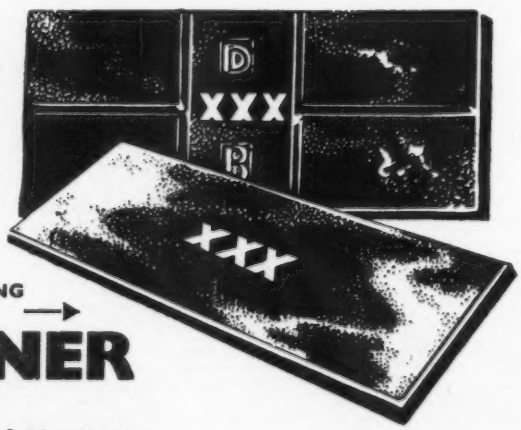

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INDEX TO ADVERTISEMENTS

	Page
Achenbach Sohne G.m.b.H.	—
Alexander Metal Co. Ltd.	20
Alkan Ltd., M. L.	6
Allan & Co. (Glenpark) Ltd., John	—
Alloy Pressure Die Products Ltd.	—
Alma Aluminium	—
Aluminum Bronze Co. Ltd.	19
A.M.T. (Birmingham) Ltd.	—
Ancorite Ltd.	—
Anglo-Swiss Alum. Co. Ltd.	—
Ashby, Morris, Ltd.	—
Ashton Ltd., N. C.	—
Associated Lead Manufacturers Ltd.	18
Associated Pressings Ltd.	21
Association of Light Alloy Refiners and Smelters Ltd.	—
Aston Chain & Hook Co. Ltd.	—
Aston Tubes (Non-Ferrous) Ltd.	—
Atlas Metals & Alloys Co. Ltd.	—
Austin & Sons (London) Ltd., E.	—
Auxiliary Rolling Machinery Ltd.	*Inside back cover*
Baird & Tatlock (London) Ltd	14
Baldwin Instrument Co. Ltd.	—
Barnett Ltd., H.	20
Batchelor Robinson & Co. Ltd.	—
Birkett, Billington & Newton Ltd.	—
Birlec-Efco (Melting) Ltd.	—
Birlec Ltd.	—
Birmetals Ltd.	—
Birmingham Aluminium Casting (1903) Co. Ltd., The	—
Birmingham Battery & Metal Co. Ltd., The	—
B.K.L. Alloys Ltd.	17
Black & Decker Ltd.	—
Blackwells Metallurgical Works Ltd.	—
Bliss (England) Ltd., E. W.	—
Blundell & Crompton Ltd	—
Boliden Gruvaktiebolag	—
Bolton & Sons Ltd., Thomas	—
Bond, Charles H.	—
Booth & Co. Ltd., J.	—
Brayshaw Furnaces Ltd.	—
Bridge Foundry Co. Ltd., The	—
Brightside Plating Co. Ltd.	—
British Aluminium Co. Ltd., The	—
British Electrical Development Association	7
British Foundry Units	—
British Furnaces Ltd.	3
British Industrial Ingot Metals Ltd.	22
Brock Metal Co. Ltd., The	—
Bronx Engineering Co. Ltd., The	—
Brookes (Oldbury) Ltd.	—
Brookes & Co. (Metals) Ltd., T. J.	—
Brookside Metal Co. Ltd.	21
Brown Corporation (Sales) Ltd., David	—
Buhler Bros.	—
Calorizing Corporation of Great Britain Ltd.	—
Camelinat & Co. Ltd., E.	—
Canning & Co. Ltd., W.	17
Carborundum Co. Ltd.	—
Case & Co. Ltd., Alfred	—
Catterson-Smith Ltd., R. M.	—
Chalmers & Co. Ltd., E.	—
Chemical Construction (G.B.) Ltd.	—
City Casting & Metal Co. Ltd.	22
Clifford Ltd., Charles	—
Cohen & Co. Ltd., A.	*Outside back cover*
Cohen, Sons & Co. Ltd., George	20
Coley & Son (Hounslow) Ltd., R. J.	—
Commercial Smelting & Refining Co. Ltd.	—
Consolidated Zinc Corporation (Sales) Ltd.	16
Coulthard & Co. Ltd., William	—
Cramic Aircraft Components Ltd.	5
Cronite Foundry Co. Ltd.	—
Cruickshank Ltd., R.	8
Dale Ltd., John	—
Davidson, F., & Co.	—
Delta Metal Co. Ltd., The	—
Deutsch & Brenner Ltd.	20
Dohm Ltd.	—
Doncaster & Sons Ltd., Daniel	—
Earle, Bourne & Co. Ltd.	—
Easdale & Co. Ltd., R. M.	—
Eclipse Foundry Engineering Co. (Dudley) Ltd.	—
Electric Resistance Furnace Co. Ltd.	—
Electro-Chemical Engineering Co. Ltd.	—
Elton Levy & Co. Ltd.	—
E.M.B. Co. Ltd.	—
Engelhard Industries Ltd.	—
Engers Ltd., M. C.	—
Enthoven & Sons Ltd., H. J.	—
Entores Ltd.	22
E.N.V. Engineering Co. Ltd.	—
Ex-Trans-Im. Ltd.	—
Eyre Smelting Co. Ltd., The	—
F. & M. Supplies Ltd.	—
Farmer Norton & Co. Ltd., Sir James	—
Fescol Ltd.	12
Fine Tubes Ltd.	—
Firma-Chrome Plating Co. Ltd., The	12
Foundry Flux Ltd.	—
Foundry Services Ltd.	—
Franklin Furnace Co. Ltd.	—
Frost & Sons (Moxley) Ltd.	—
Frost Ltd., N. T.	24
Fry's Diecastings Ltd.	—
Fry, Wm.	—
Garnham & Sons Ltd., J. B.	—
Gas Council, The	—
General Refractories Ltd.	10
Gibbins & Bodenham Ltd.	—
Gibbons Brothers Ltd.	—
Gibbons (Dudley) Ltd.	—
Gills Pressure Diecastings Ltd.	—
Grauer & Weil Ltd.	—
Great Bridge Foundry Co. Ltd.	—
G.W.B. Furnaces Ltd.	4, 13
Hadfields Ltd.	—
Hampton Works (Stampings) Ltd.	—
Hall Foundries Ltd.	—
Hall Street Metal Rolling Co. Ltd.	—
Harris (Birmingham) Ltd., F. W.	—
Harris Plating Works Ltd.	12
Head Wrightson Machine Co. Ltd.	—
Heneage Metals Ltd.	—
Hilger & Watts Ltd.	—
Hockley Chemical Co. Ltd.	—
Holroyd & Co. Ltd., John	—
Hudson & Edmonds	—
Ilfar Aluminium Co. Ltd.	12
Imperial Chemical Industries Ltd.	11
Industrial Research Laboratories	22
International Alloys Ltd.	2
International Refining Co. Ltd.	22
Ireland (Wolverhampton) Ltd., John	—
Jackson & Son Ltd., E. W.	—
Johnson & Co. (Birmingham) Ltd., George	22
Johnson & Sons Smelting Co. Ltd.	21
Jones & Co. Ltd., R.	—
Jones & Rooke (1948) Ltd.	*Inside back cover*
Jones Ltd., George	—
Joseph & Sons Ltd., M.	—
Laidlaw Drew & Co. Ltd.	—
Lazarus Ltd., Leopold	*Inside front cover*
Lead Development Association	—
Lead Wool Co. Ltd., The	—
Lees Hall & Sons Ltd.	—
Levick Ltd., John	—
Levy & Co. (Patterns) Ltd., B.	—
Lindemann Maschinenfabrik G.m.b.H.	—
Loewy Eng. Co. Ltd., The	—
McKechnie Bros. Ltd.	—
Magnesium Elektron Ltd.	21
Manganese Bronze & Brass Co. Ltd.	—
Marshall-Richards Machine Co. Ltd.	—
Metal Alloys (South Wales) Ltd.	—
Metal Castings Ltd.	*Outside front cover*
Metallisation Ltd.	—
Metal Scrap & By-Products Ltd.	—
Metallurgical (Essex) Ltd.	—
Metals & Methods Ltd.	18
Midland Metallics Ltd.	—
Midland Monolithic Furnace Lining Co. Ltd.	—
Milner Metals Ltd., A. E.	19
Mint, Birmingham, Ltd., The	—
Mitcham Smelters Ltd.	—
Modern Furnaces & Stoves Ltd.	—
Mond Nickel Co. Ltd., The	—
Monometer Manufacturing Co. Ltd.	9
Morris Ltd., B. O.	—
Morris, & Son (Birmingham) Ltd., Wm.	—
Mould Bros. (Camp Hill) Ltd.	—
Murcott, J. V., Ltd.	—
National Industrial Fuel Efficiency Service	—
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Perry & Co. Ltd., B. J	—
Philipp & Lion	—
Platt Metals Ltd.	—
Pontifex & Sons Ltd., H.	—
Powder Metallurgy Ltd.	19
Priestman Ltd., T. J.	—
Rapid Magnetic Ltd.	—
Rhondda Metal Co. Ltd.	—
Richardson & Son Ltd., R. J.	—
Righton & Co. Ltd, Henry	—
Robertson & Co. Ltd., W. H. A.	—
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Schloemann Aktiengesellschaft	—
Scott, A. C., & Co. Ltd.	—
Senier & Co. Ltd, T. W.	8
Shardal Castings Ltd.	23
Sheffield Smelting Co. Ltd.	—
Shell-Mex & B.P. Gases Ltd.	—
Sheppard & Sons Ltd.	—
Silvercrown Ltd.	—
Simpson (Assayer) Ltd., Gordon	—
Sklenar Furnaces Ltd.	—
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Steele & Cowlishaw Ltd.	—
Stein & Atkinson Ltd.	—
Stein & Co. Ltd., John G.	—
Strebor Diecasting Co. Ltd.	—
Stuart (London) Ltd., Robert	12
Sunbeam Anti-Corrosives Ltd.	—
Sundwiger Eisenhutte (Grah & Co.)	—
Svenska Aluminium Kompaniet AB	—
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Tungum Co. Ltd, The	—
Union Carbide Ltd.	—
Verichrome Plating Co. Ltd.	—
Vickers-Armstrongs Engineers Ltd.	6
Vincent Eng. Co. Ltd.	—
Wedge Ltd., B. E.	—
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West Yorkshire Foundries Ltd.	—
Westinghouse Brake & Signal Co. Ltd.	—
Wilkes Chemical Co. Ltd., Henry	—
Williams Brothers & Piggott Ltd.	—
Wolverhampton Diecasting Co. Ltd., The	—
Wolverhampton Metal Co. Ltd.	1
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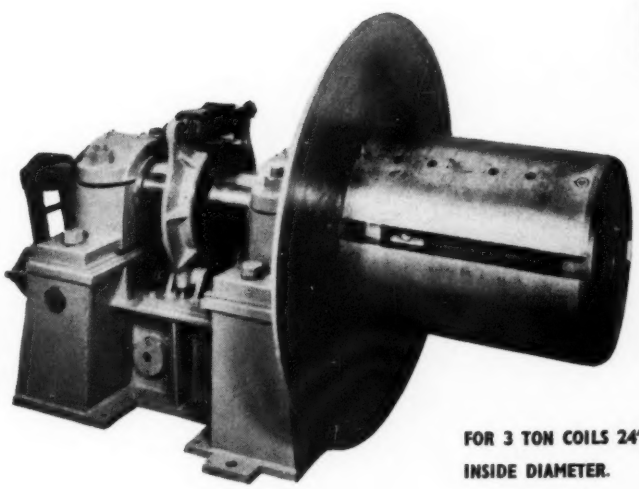

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